GOOD AGRICULTURAL PRACTICES (GAP) FOR FRUITS AND VEGETABLE FARMING - CODE OF PRACTICE

PNS/BAFS 49:2021

EXPLANATORY MANUAL

DEPARTMENT OF AGRICULTURE (DA)
BUREAU OF AGRICULTURE AND FISHERIES STANDARDS
(BAFS)

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Explanatory Manual

Good Agricultural Practices (GAP) for Fruits and Vegetable Farming - Code of Practice (PNS/BAFS 49:2021)

Department of Agriculture (DA)
Bureau of Agriculture and Fisheries Standards (BAFS)
Quezon City, 2023

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Introductory Note

This Explanatory Manual (EM) complements the Philippine National Standard (PNS) Good Agricultural Practice (GAP) for Fruits and Vegetable (FV) Farming - Code of Practice (PNS/BAFS 49:2021). The PNS covers the general hygienic practices for the production and primary processing of fresh fruits and vegetables cultivated for human consumption, particularly those intended to be consumed raw. Specifically, the PNS applies to fresh fruits and vegetables that are field-grown with or without cover or those grown under protected facilities such as hydroponic systems or greenhouses.

The Technical Working Group (TWG) that developed this EM is composed of representatives from the Bureau of Plant Industry (BPI), the Fertilizer and Pesticide Authority (FPA), and the University of the Philippines Los Banos (UPLB). The creation of this TWG was formalized through Special Order (SO) No. 272, series of 2023, giving formal authority to form TWG for the Development of Knowledge Products of PNS.

The EM is designed to help readers further understand the provisions of the PNS, regardless of whether they are regulatory personnel, extension workers, industry professionals, or individuals interested in GAP. It also aims to provide further clarity, insights, and inspiration for the target industry to adopt and implement the PNS requirements.

The explanatory notes in the PNS are primarily sourced from publications of reputable organizations and anecdotal experiences, enhancing the comprehensibility of the content. DA-BAFS extends its appreciation to the selected private GAP-certified farm owners who allowed the documentation of their farm practices. Likewise, it also extends its appreciation to the TWG members for providing the needed photographs of facilities, practices, and products from their personal collection.

Director's Message

I am pleased to share with you the result of a collaborative effort between the DA-BAFS and the DA-BPI, in partnership with the TWG created for a specific purpose. It is my privilege to present to you the EM for the PNS on the Code of GAP for Fruits and Vegetable Farming.

Nowadays, we will find a dearth of information, education and communication materials related to GAP and its certification. Likewise, we will find numerous training service providers that conduct GAP and GAP certification trainings targeted to specific audiences, such as agricultural extension workers, regulatory personnel, farmers, and farm owners. While we find the increasing interest on GAP and its certification noteworthy, there is found a significant gap in terms of harmonization and consistency in understanding GAP principles, concepts, and requirements. This is where the PNS on GAP plays a crucial role in ensuring uniform knowledge, understanding, and application of requirements, across all target audiences.

More specifically, this EM on the PNS on the Code of GAP for Fruits and Vegetable Farming will serve as a tool for an in-depth understanding of the PNS provisions. It is targeted to the Philippine GAP (PhilGAP) inspectors, GAP teams, and agricultural extension workers to assist them in performing their respective roles on GAP inspection, certification, and training. This EM has been meticulously written to provide explanatory notes and images on provisions that may be subject to different interpretations. The EM also serves as a user-friendly guide to support farmers in their daily activities and for agricultural extension workers as a comprehensive reference material for training purposes.

May I encourage you to utilize this valuable resource to further our goal of ensuring the availability of safe and high-quality agricultural products, which are produced with consideration for the heath and welfare of agricultural workers and environmental protection.

KAREN KRISTINE A. ROSCOM, PhD, PFT
Director IV

List of Commonly Used Acronyms

BAFE	Bureau of Agriculture and Fisheries Engineering
BAFS	Bureau of Agriculture and Fisheries Standards
BSWM	Bureau of Soils and Water Management
BPI	Bureau of Plant Industry
DA	Department of Agriculture
DENR	Department of Environment and Natural Resources
DOST	Department of Science and Technology
FPA	Fertilizer and Pesticide Authority
FIFO	First-in First-out
FAO	Food and Agriculture Organization
LGU	Local Government Unit
MAP	Modified Atmosphere Packaging
MAO	Municipal Agriculture Office
MRL	Maximum Residue LImits
NSIC	National Seed Industry Council
OBCA	Organic Biocontrol Agents
OSA	Organic Soil Amendment
PCAARRD	Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development
PNS	Philippine National Standard
PHTRC	Postharvest Horticulture Training and Research Center
RFO	Regional Field Office
SNAP	Simple Nutrient Addition Program
UPLB	University of the Philippines Los Banos

List of Related Laws and Regulations

Republic Act No. 8749, Philippine Clean Air Act of 1999
"An Act Providing for a Comprehensive Air Quality Control Policy and for Other Purposes"

Republic Act No. 9275, Philippine Clean Water Act of 2004
"An Act Providing for Comprehensive Water Quality Management and Other Purposes"

Republic Act No. 9003, Ecological Solid Waste Management Act of 2000
"An Act Providing for an Ecological Solid Waste Management Program, Creating the Necessary Institutional Mechanisms and Incentives, Declaring Certain Acts Prohibited and Providing Penalties, Appropriating Funds Therefor, and for Other Purposes"

Republic Act No. 9147, Philippine Biodiversity Conservation Act of 2001
"An Act Providing for the Conservation and Protection of Wildlife Resources and Their Habitats, Appropriating Funds Therefor and for Other Purposes"

Republic Act 6969, The Toxic Substances and Hazardous and Nuclear Waste Control Act
"An Act to Control Toxic Substances and Hazardous and Nuclear Wastes, Providing Penalties for Violations Thereof, and for Other Purposes"

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Foreword

The DA-BAFS Technical Services Division (TSD) generated a Priority List for PNS Promotion for 2023 based on established prioritization criteria. This included the PNS GAP for Fruits and Vegetable Farming - Code of Practice (PNS/BAFS 49:2021). This standard covers the general hygienic practices for the production and primary processing of fresh fruits and vegetables cultivated for human consumption, particularly those intended to be consumed raw. Specifically, this Code applies to fresh fruits and vegetables that are field-grown with or without cover or those grown under protected facilities such as hydroponic systems or greenhouses.

To assist the BPI Food Safety Officers, the DA Regional Field Offices, and the Food Safety Control Officers, an EM was developed to provide supplementary material to the standard, further clarify the text of the standard, and provide more specific details on the minimum requirements. The TWG, created specifically for the purpose, assisted in completing the EM in 2023, given the expressed urgency for this supplementary material to ensure consumer safety and facilitate trade.

To create this EM, a series of meetings and writeshop were conducted. The photographs and other relevant information gathered were incorporated into the supplementary material. The TWG discussed and finalized the draft over a period of 7 months (April to October 2023) before it was submitted to DA-BAFS for final editing, proofreading, and layout.

Section 1

Scope

Photo source: Canva, n.d.

1 Scope

This standard code of practice covers the general hygienic practices for the production and primary processing of fresh fruits and vegetables cultivated for human consumption, particularly those intended to be consumed raw. Specifically, this code is applicable to fresh fruits and vegetables that are field-grown with or without cover, or those grown under protected facilities such as hydroponic systems or greenhouses.

This standard code does not apply to the production of sprouts, fresh cut products and other products that are covered by separate production or certification standards.

Section 2

Normative References

2 Normative References

The referenced document is indispensable for the application of this document. Only the edition cited applies.

Association of Southeast Asian Nations (ASEAN). (2006). *Good Agricultural Practices (GAP) for production of fresh fruits and vegetables in the ASEAN Region*. https://org.doa.go.th/aseancrops/?wpfb_dl=4

Section 3

Definition of Terms

3 Definition of Terms

3.1
agricultural inputs
any incoming material (e.g., seeds, fertilizers, water, agricultural chemicals, plant support, etc.) used for the primary production of fresh fruits and vegetables

3.2
agricultural worker
any person that undertakes one or more of the following: cultivation, harvesting, and packing of fresh fruits and vegetables

3.3
antimicrobial agents
any substance of natural, synthetic or semi-synthetic origin which at low concentrations kills or inhibits the growth of microorganism but causes little or no host damage

3.4
biological control
use of competing biologicals for the control of pests (such as insects, mites, plant pathogens and spoilage organisms)

3.5
biopesticide
pesticide that is manufactured from biological sources

3.6
biosolids
sludge and other residue deposits obtained from sewage treatment plants and from treatments applied to urban and industrial wastes (food industry or other types of industries)

3.7
cleaning
removal of soil, dirt, grease or other foreign matter

3.8
clean water
water that does not compromise food safety in the circumstances of its use

3.9
composting
managed process where organic materials are subjected to moisture, heat and microorganisms for a specified period to produce a product known as compost

3.10
contamination

food safety context:
introduction or transfer of a food safety hazard to the produce or to the inputs, such as soil, water, chemicals, equipment and people that contact produce

environmental context:
introduction or occurrence of a hazard into the environment

3.11
domesticated animals and wild animals
animals that are raised as family pets or as a source of food for the family – for example dogs, cats, cows, chickens, ducks, birds, sheep, monkeys, mice, rabbits

3.12
farm animals
animals that are raised for agricultural and commercial purposes – for example, cows, carabaos, sheep, chickens and ducks

3.13
fertigation
application of nutrients through an irrigation system

3.14
fertilizer
includes any substance – solid or liquid – or any nutrient element or elements – organic or inorganic – single or in combination with other materials, applied directly to the soil for the purpose of promoting plant growth, increasing crop yield or improving their quality

3.15
DA-FPA-certified pesticide applicator (agricultural category)
refers to one who has attended training course and passed an examination administered for such purpose of safe use including storage, disposal of pesticide by the DA-FPA

3.16
food safety hazard
any chemical, biological or physical substance or property that can cause fruit and vegetables to become an unacceptable health risk to consumers

3.17
fumigation
application of a chemical to control pests in the soil or substrate, such as insects, diseases and weeds

3.18
hazard
biological, chemical or physical agent in, or condition of, food with the potential to cause an adverse health and environmental effect/s

3.19
integrated pest management
system for managing pests that integrates multiple strategies to minimize the use of chemical pesticides, such as encouraging beneficial insects and microorganisms to flourish, good crop hygiene and plant health, regular monitoring of crops for pests, using biological control agents and soft pesticides, and selective use of chemical pesticides

3.20
manure
animal excrement which may or may not be mixed with litter or other material, and which may be fermented or otherwise treated

3.21
maturity index
method used to measure or predict the maturity of fruit and vegetables

3.22
Maximum Residue Limit (MRL)
maximum concentration of a pesticide residue (expressed as mg/kg) recommended by either Codex Alimentarius Commission or national competent authority to be legally permitted in or on food commodities. MRLs are based on GAP data (on the use of pesticide) and foods derived from commodities that comply with the respective MRLs are intended to be toxicologically acceptable.

3.23
obsolete chemical
chemical that is no longer suitable for use. For example, approval for use of the chemical may be withdrawn, the chemical is older than the use by date, the container may be damaged and the chemical soiled.

3.24
organic material
material originating from plants and animals and not from synthetic sources

3.25
packing
action of putting fresh fruits and vegetables in a package. This may take place in a field or in the establishment

3.26
pest
unwanted animal or plant that affects the production, quality and safety of fruit and vegetables – for example, insects, diseases, weeds, rodents and birds

3.27
pesticide
products used to control pests – for example, insecticides, fungicides, herbicides, fumigants. Pesticides can be manufactured from chemical or biological resources.

3.28
pesticide residue
any specified substance in food, agricultural commodities, or animal feed resulting from the use of a pesticide. The term includes any derivatives of a pesticide, such as conversion products, metabolites, reaction products, and impurities considered to be of toxicological significance.

3.29
potable water
water that is suitable for human consumption as approved by WHO or equivalent regulations

3.30
Pre-Harvest Interval (PHI)
refers to the number of days between the last spraying and harvest. It is derived from a supervised pesticide residue trial where the pesticide is applied at the recommended rates and the residue levels are analyzed. Each pesticide active ingredient or AI has its own PHI.

3.31
primary processing
part of a food processing plant that receives raw materials and prepares them for further processing, e.g., by cleaning, milling or separating

3.32
re-entry period
refers to the period of time immediately following the application of a pesticide during which unprotected workers should not enter a field

3.33
risk
chance of something happening that will impact upon a hazard (for example, food safety, environmental, occupational). It is usually measured in terms of likelihood and consequences.

3.34
sanitize
reducing the level of microorganisms through using chemicals, heat and other methods

3.35
sensitive areas
areas at high risk of environmental harm from chemicals, water, nutrients, waste, and so on, originating from property activity. Examples include biodiverse areas, other crops, livestock areas, water sources, marine areas, wetlands, native fauna and flora, soils, neighboring properties and public areas.

3.36
site
defined area on the property – for example, a production site

3.37
soil additives
products or materials that are added to the soil to improve fertility, structure or control weeds. Examples are animal manure, sawdust, compost, seaweed, fish- based products.

3.38
traceability
ability to follow the movement of produce through the specified stages of production and distribution

3.39
untreated organic materials
organic materials that did not undergo decomposition or the process of breakdown into simpler forms

3.40
urban waste
domestic waste (from residential settlements) or a mixture of domestic waste with industrial waste (from premises used for trade or industry)

Section 4

Recommended Practices

The provisions of the standard are written in black font color. Additional information such as notes, images and anecdotal practices are provided as Explanatory Notes inside a yellow box in black font color.

Photo source: UPLB, 2023

4.1 Site History and Management

4.1.1 Suitability of the Agricultural Site for Food Production and Primary Processing

4.1.1.1 Management of site activities conforms to country environmental legislation covering air, water, noise, soil, biodiversity and other environmental issues.

Explanatory Note:

The following are some of the key legislations and corresponding provision related to the management of sites:

Table 1. **Key legislations relevant to the management of site activities**

Legislation	Provision related to management of site
1. RA No. 8749, Philippine Clean Air Act of 1999 This Law aims to protect and preserve the quality of air in the Philippines. It sets emission standards for industries and vehicles, and it regulates sources of air pollution. It also establishes the framework for the development and implementation of air quality management plans.	Restricts open burning, including field clearing, due to its potential to release pollutants into the air.
2. RA No. 9275, Philippine Clean Water Act of 2004 This Law focuses on the protection, preservation, and sustainable development of the country's water resources. It regulates the discharge of pollutants into water bodies and encourages the use of appropriate wastewater treatment technologies.	Emphasizes proper sewage and wastewater management, including those generated by farming operations, and ensures that farms are equipped with suitable sewage and wastewater treatment systems to prevent water body contamination.
3. RA No. 9003, Ecological Solid Waste Management Act of 2000 This Law addresses the proper management of solid waste, including waste reduction, segregation, recycling, composting, and disposal. It aims to minimize the generation of solid waste and promote environmentally sound waste management practices.	Requires that farming operations that generate hazardous waste (e.g. chemicals or pesticides), have procedures and facility where these hazardous wastes can be stored, transported, and disposed properly.

Legislation	Example
4. RA 9147, Philippine Biodiversity Conservation Act of 2001 This Law enables the government to manage and conserve the wildlife resources of the country comprehensively.	Restricts/regulates farming activities in protected areas to prevent hard to sensitive ecosystems.

The provided list of legislation is not exhaustive. The DENR also issues specific directives concerning these legislations. It is recommended to visit the DENR website at www.denr.gov.ph for more comprehensive information.

4.1.1.2 In the case of new site(s), the risk of causing environmental harm within or outside the site should be assessed for the proposed use. Risk assessment should consider the prior use of the site and potential impact of adjacent sites to the new site(s).

Explanatory Note:

Environmental hazards may be present as a result of the production, harvesting, and postharvest handling activities of fruits and vegetables. Circumstances specific to the site need to be considered when identifying and managing potential environmental hazards.

As defined in RA No. 10611 or the Food Safety Act (FSA) of 2013, a *hazard* is defined as any biological, chemical, or physical agent in food that can potentially cause adverse health effects. Meanwhile, *risk* refers to the likelihood of an adverse health effect and the severity of this effect following exposure to a hazard.

For the **conduct of risk assessment**, the following are the basic risk assessment steps:

1. Identification of hazards

Hazards can be identified by:

- observing the site,
- learning the history of the site usage, and
- seeking information from neighbors regarding their activities.

2. Evaluation of risks and implementation of precautionary measures

Precautionary measures that can be implemented are based on the evaluated risks. In doing the evaluation, the assistance of local authorities (e.g., local government unit or DA Regional Field Office) is valuable.

Other sources of useful and relevant information are published research and references. From the results of the evaluation, the corresponding measure will help eliminate or minimize the hazards and risks identified.

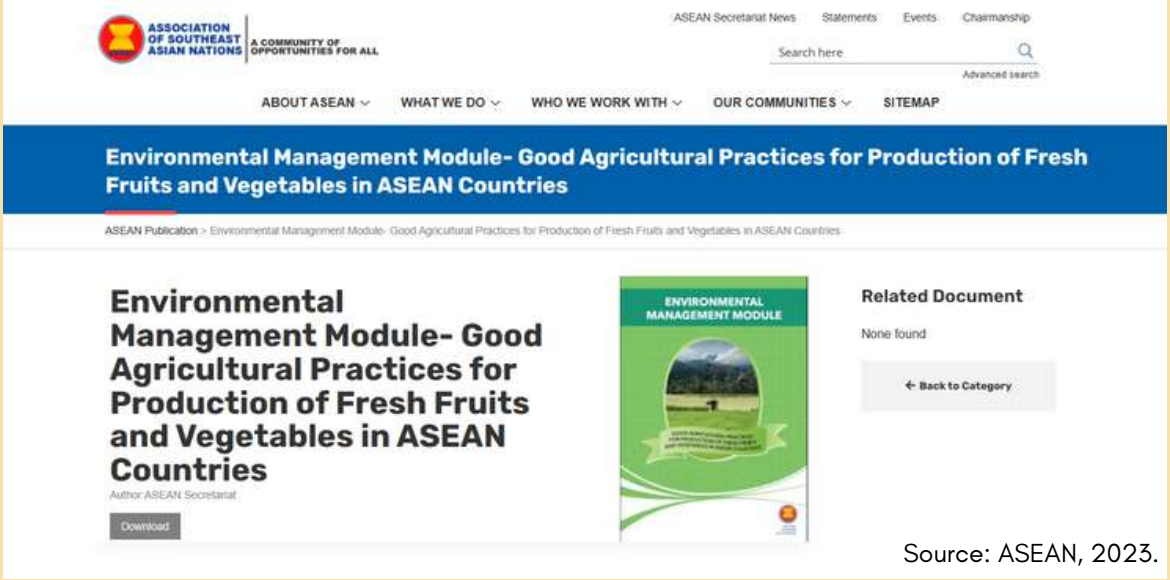
3. Implementation changes, as appropriate.

Actions are taken based on assessment findings, with the most critical issues given the immediate attention.

4. Monitoring and review

Regular monitoring and review of actions provide the necessary information on the effectiveness of measures or changes made to address the hazards identified and minimize the risks. The routine of reviewing assessments is established even if no major changes occur.

The ASEAN GAP Environmental Management Module listed the potential environmental hazards, and their associated environmental impacts. The TWG modified the list incorporating possible control measures, as presented in Table 2.



Source: ASEAN, 2023.

Image 1. **ASEAN GAP Environmental Management Module available for download on their website**

The Environmental Management Module- Good Agricultural Practices for Production of Fresh Fruits and Vegetables in ASEAN Countries is available for download at the ASEAN website https://asean.org/.

The table below grouped the hazards into the following categories: land and soil, water, chemicals, nutrients, biodiversity of fauna and flora, waste, air and energy.

Table 2. Examples of environmental hazards, its associated impact, and possible control measures

Category	Hazard	Associated environmental impacts	Control measure/s
Land and soil	Soil erosion *Examples but not limited to:* • *Contour farming not being practiced in sloping areas*	Sedimentation of rivers and waterways Nutrients and chemicals entering rivers and waterways i.e. eutrophication	Practice contour farming
	Poor soil structure *Examples but not limited to:* • *Use of heavy machineries/equipment* • *Poor land preparation*	Compaction of the soil Increased run-off Nutrient depletion	Use of smaller machineries/equipment Proper land preparation
	Salinity *Examples but not limited to:* • *Installation of Shallow Tube Well (STW)*	Reduction of arable land Loss of biodiversity	
	Soil acidity and alkalinity • *Improper use of fertilizer*	Reduction of productivity Reduction of arable land	Follow the manufacturer's directions in using fertilizer
Water	Depletion of water resources *Examples but not limited to:* • *Installation of Shallow Tube Well (STW)* • *Cutting of trees*	Insufficient water supply and environmental flow Depletion of water table Rising water table and waterlogging	Avoid cutting of trees

(continued)

Category	Hazard	Associated environmental impacts	Control measure/s
Water	Poor water quality *Examples but not limited to:* • *Improper disposal of wastewater*	Contamination of water by fertilizers, chemicals, fuels, oils and sedimentation	Wastewater disposal system
Chemicals	Contamination of environment from inappropriate storage, application and disposal of chemicals	Contamination of surface and groundwater Contamination of drinking water Loss of biodiversity Soil contamination Adverse impact on other crops and adjacent properties	Practice proper storage, application and disposal of chemicals
	Spray drift *Examples but not limited to:* • *Improper spraying*	Adverse effect on surrounding crops Disruption of Integrated Pest Management strategies Health risks for local residents	Apply directly to the intended area Spray during calm weather conditions
Nutrients	Degradation of soil and water *Examples but not limited to:* • *Improper use of fertilizer*	Soil acidification Reduction of water quality – eutrophication Loss of biodiversity	Follow the manufacturer's directions in using fertilizer

(continued)

Category	Hazard	Associated environmental impacts	Control measure/s
Biodiversity	Reduction of wildlife corridors *Examples but not limited to:* • *Logging* • *Conversion of forest land for agriculture*	Loss of biodiversity Changes in pest species	Avoid cutting trees Avoid farming in critical habitats
Waste	Pollution *Examples but not limited to:* • *Improper waste management*	Contamination of soil and water Greenhouse gas emission Inconvenience to local residents	Practice proper waste management
	Depletion of natural resources *Examples but not limited to:* • *Excessive mining* • *Deforestation*	Wasting non-renewable resources Waste disposal sites required (landfill)	Mine rehabilitation Reforestation
Air	Dust *Examples but not limited to:* • *Non use of cover crops*	Sedimentation of waterways Inconvenience for local residents	Use of cover crops
	Smoke *Examples but not limited to:* • *Illegal burning*	Creation of greenhouse gases Inconvenience for local residents	No burning
	Greenhouse gases *Examples but not limited to:* • paddy rice • improper fertilization • Illegal burning	Global warming and climate change	

Note: Guidelines for Environmental Assurance in Australian Horticulture, Horticulture Australia Limited., www.horticulture.com.au

(continued)

Category	Hazard	Associated environmental impacts	Control measure/s
	Noise	Inconvenience for local residents Loss of biodiversity	Eliminate or isolate noisy operations or activities
	Energy	Depletion of natural resources *Examples but not limited to:* • Excessive use of farm machineries	Creation of greenhouse gases

Note: Guidelines for Environmental Assurance in Australian Horticulture, Horticulture Australia Limited., www.horticulture.com.au

4.1.1.3 If results of the evaluation of the production or adjoining sites lead to the conclusion that potential hazard exists, the sites should be further evaluated through analysis and characterization of the identified contaminants.

Explanatory Note:

Government institutions and private testing laboratories can provide analysis and characterization of contaminants. Below are some of the government institutions that can provide laboratory services:

DOST - Industrial Technology Development Institute (DOST-ITDI)
Address: DOST-ITDI Bldg., DOST Cmpd., General Santos Avenue, Bicutan, Taguig City, Philippines
Contact No. : (632) 86837750 local 2182, (632) 88372071 local 2182

DA BSWM Management and its Regional Laboratories
Address: SRDC Bldg. Elliptical Road corner Visayas Avenue, Diliman, Quezon City, Philippines 1101
Contact number: (8)529-7640 local 301

These government institutions have regional counterparts that extend laboratory services to various regions throughout the Philippines. For private testing laboratories, the website of the Department of Trade Industry (DTI)-Philippine Accreditation Bureau (PAB) provides the list of accredited testing laboratories: https://pabaccreditation.dti.gov.ph/

4.1.1.4 If the contaminants are found to be at unacceptable levels, the site should not be used for production and primary processing until corrective or control measures are carried out.

4.1.1.5 Whenever remedial action is required to manage the risk, the action taken should be monitored to ensure that contamination of the produce is eliminated or kept within acceptable levels.

Explanatory Note:

For instance, consider a farm that encounters poor water quality due to nearby agricultural activities. To manage this risk, the following remedial actions may be taken:

Hazard:	Poor water quality
Possible impact:	Contamination of water by fertilizers, chemicals, fuels, oils, and sedimentation
Monitoring activity:	Regular water testing or as deemed necessary

4.1.2 Production Site and Property Map

4.1.2.1 A property lay-out map within the site should be prepared to indicate the locations of the following:

a) crop production area;
b) primary processing area;
c) sources of water used on the farm (well, reservoir, rivers, lakes, farm ponds, etc.);
d) chemical pesticides and fertilizer storage and mixing areas;
e) tools and equipment cleaning and disinfection areas;
f) storage area for tools and equipment;
g) post-harvest chemical treatment area;
h) water storage, distribution networks, drainage, and discharge points of waste water;
i) solid waste disposal area;
j) composting areas;
k) property buildings, structures and road networks;
l) toilet facilities and hand-washing areas; and
m) environmentally sensitive and highly degraded areas (e.g., saline/sodic soil).

Explanatory Note:

The **property map can be as simple as a line drawing or a more detailed aerial map** with overlays to indicate the locations of the available facilities within the farm. The following are some of the facilities that can be found in a farm:

1. crop production area;
2. sources of water used on the farm (well, reservoir, rivers, lakes, farm ponds, etc.);
3. chemical pesticides and fertilizer storage and mixing areas;
4. water storage, distribution networks, drainage, and discharge points of wastewater;
5. solid waste disposal area;
6. property buildings, structures, and road networks; and
7. toilet facilities and hand-washing areas

The **purpose** of the property layout map and vicinity map is to **help the farmer identify potential sources of hazards.** For example, the storage area for chemicals should not pose a risk to the production, processing, and packing area, the workers, and the neighborhood. Below are sample illustrations and an actual farm property map for reference.

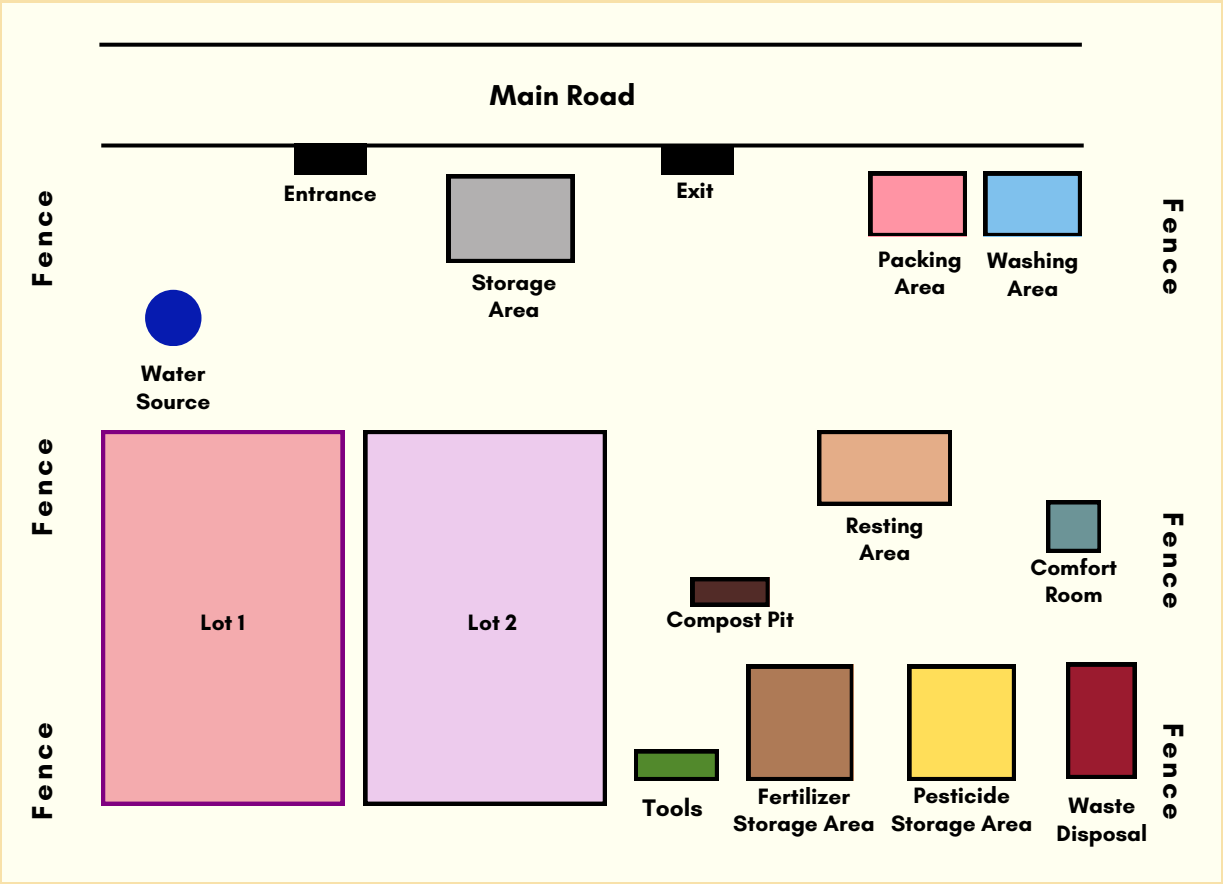


Image 2a. **A sample Illustration of a property layout map**

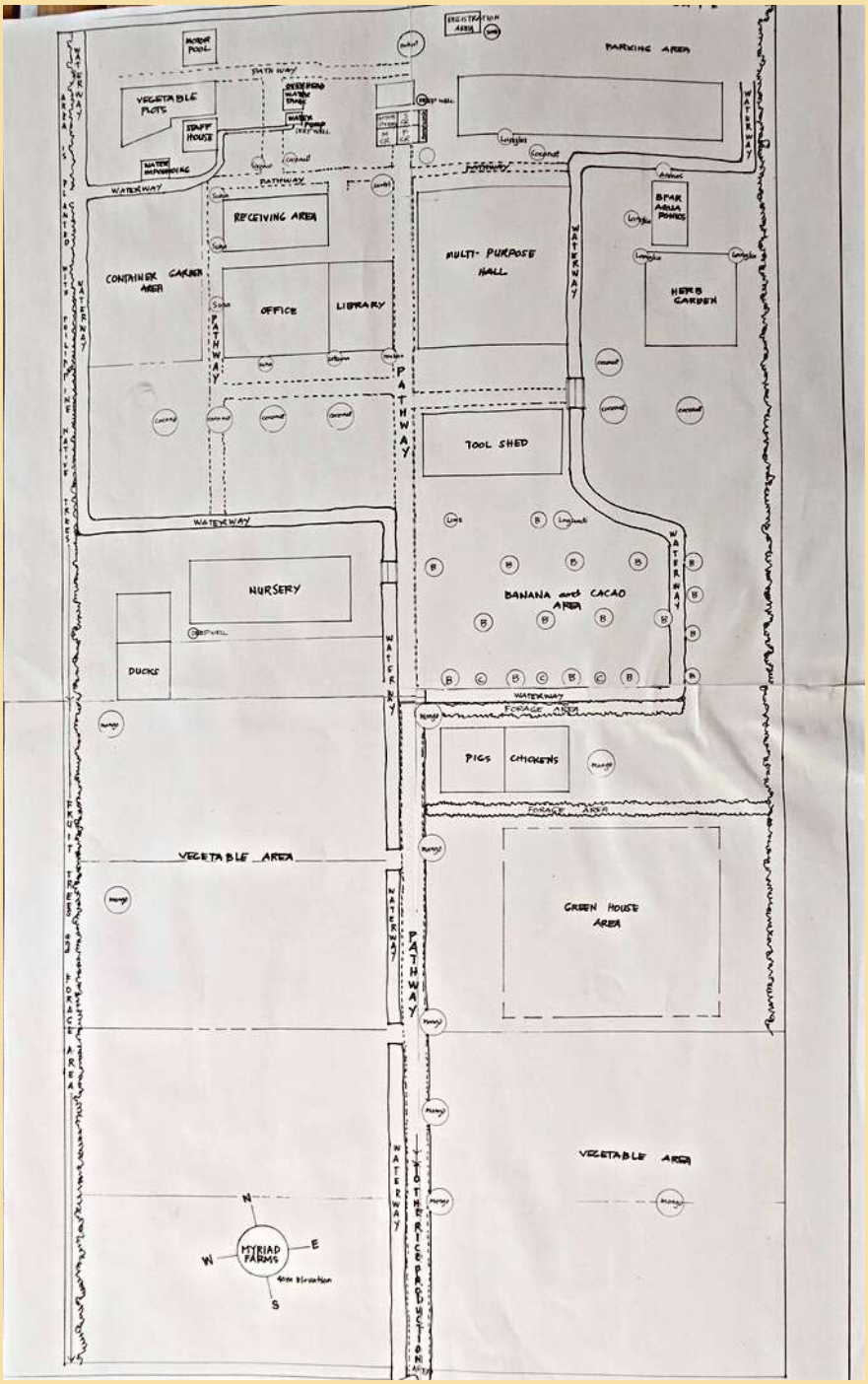


Image 2b. **A sample of an actual property farm layout of a GAP Certified farm in Region III**

Storage facilities for fertilizers, pesticides, toilets, and other farm amenities may not necessarily be constructed with complete concrete. The crucial factor is their **correct placement within the farm, serving their intended purpose in effectively preventing contamination** of the produce and for other purposes, as discussed in the PNS in the subsequent sections.

Farmers may also seek assistance from the DA Regional Field Office in determining the Global Positioning System (GPS) coordinates of the farm location.

Image 2c. **Farm layout with GPS coordinates sourced through Google Maps**

4.1.2.2 Each production area, in case of multiple production areas in a site, should be identified by a name or Code, and must be indicated in the property map.

Explanatory Note:

Assigning or identifying a production area with a **Name Code facilitates an organized production zoning and will help in identifying potential risks** to the area. This will also **help trace the source** of the produce.

Image 3. **Production area with plot code**

4.2 Planting Material

4.2.1 Selection of Planting Materials Considers Soil and Site Suitability/ Compatibility

4.2.1.1 Aside from yield quantity and quality as basic considerations, varieties to be grown should be selected based on market requirements, grower preference and adaptability to the locality. Other considerations may include soil type and nutrient levels, water availability, prevailing temperatures and humidity, insect pest population dynamics, and presence of inocula of major pathogens.

4.2.1.2 For efficient chemical, water and other input utilization, planting materials may be selected based on their nutrient and water use efficiencies, and pests and diseases resistance.

Explanatory Note:

Selecting planting materials that are r**esistant to pests and diseases will reduce the need for chemical pesticides and the risk of chemical contamination of the environment.** Planting material can be a source of chemical contamination through chemicals used to treat seeds or control pests during nursery production.

The DA – National Seed Industry Council (NSIC) issues a **List of Registered Varieties of Crops** that are reliable and superior in field performance.

The NSIC List of Commercial Crops serves as a reference for farmers, seed producers, and other stakeholders to identify approved and recommended crop varieties that have undergone evaluation and testing for their performance, adaptability, and quality.

The list is available in their database at https://nsic.buplant.da.gov.ph/ccvd/.

4.2.1.3 Crop varieties/species known to be toxic for human consumption are not grown.

4.2.2 Source of Planting Material, The Necessary Seed Treatments and Related Documents

4.2.2.1 The seed and planting materials should be of high quality. Sourcing and/or procurement of seed and planting materials from the Accredited Seed Growers or Plant Nursery Operators are encouraged.

Explanatory Note:

The BPI regulates the production, distribution, and regulation of breeder, foundation, and registered seeds (Seed Industry Development Act 1992/RA 7308 S. 1992). The list of accredited seed growers or plant nursery operators is available at the BPI website at https://www.buplant.da.gov.ph.

High-quality seeds and planting materials help ensure better yields and healthier plants. Sourcing them from Accredited Seed Growers and Plant Nursery Operators provides confidence that you are obtaining reliable and trusted materials.

Image 4a. **Nursery area of a large scale farm**

Image 4b. **Nursery of a small scale farm**

Image 4c. **Seedlings with label for tracebility**

4.3 Soil and Soil Conservation

4.3.1 General

4.3.1.1 Recommended soil conservation measures such as: minimum tillage, contour planting, crop rotation, etc. should be integrated in the crop production practices in order to improve or maintain the soil structure and tilth, and minimize soil compaction and erosion.

Explanatory Note:

Minimum tillage

- Reduce soil disturbance and carbon emissions.
- Enables the use of smaller tractors, reducing fuel and maintenance expenses (FAO, 2001).

Contour planting

- Prevents soil erosion and runoff by collecting rainfall behind ridges (Gilley, 2005).

Crops rotation

- Prevent the build-up of pests and diseases by planting crops belonging to different families within 1 to 2 years.

4.3.1.2 Use of crop suitability maps to plan crop rotation and production programs is encouraged.

Explanatory Note:

A crop suitability map is a geographical representation that **provides information on the suitability of growing a crop in a specific area**. This considers environmental factors, physical characteristics, and soil fertility, including agro-climatic conditions, land suitability for farming practices, and soil fertility (Adornado and Yoshida, 2008).

Crop suitability map and other related agricultural information are also available from government agencies, research institutions, and international organizations, such as:

1. DA-BSWM is a Bureau under the DA that can conduct soil and land resource mapping and evaluation.

2. DOST-PCAARRD is a government agency that provides research and development support for the agriculture and fisheries sectors, including resources related to crop suitability mapping and agricultural research.

3. Universities and Research Institutions
   Universities and research institutions typically conduct studies on agricultural practices and suitability mapping.

4. International Organizations
   Organizations like the FAO may offer resources and expertise on crop suitability and agricultural research in the Philippines.

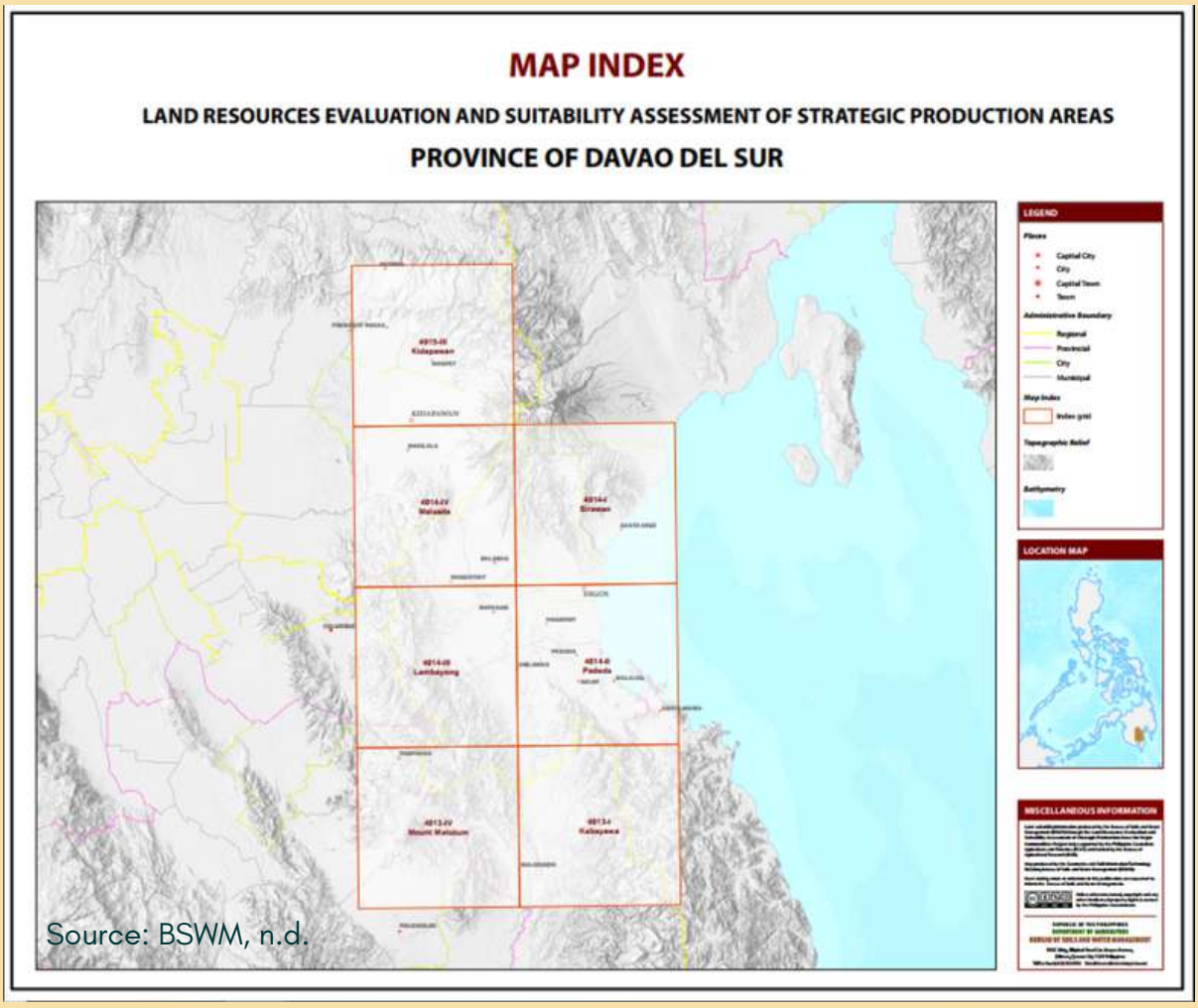


Image 5a. **A sample land suitability map for Robusta coffee**

In addition, a useful tool to plan crop rotation and production programs is a cropping or planting calendar. Planting calendar can:

- serve as a guide on the growing season of crops; and
- help in better planning of all farm activities, thus, lowering the cost of production (Yulianti & Dewi, 2021).

Sample planting calendar of vegetable crops may be accessed through https://www.buplant.da.gov.ph.

PLANTING CALENDAR

GUIDE ON PLANTING AND GROWING VEGETABLE CROPS

BUREAU OF PLANT INDUSTRY
CROP RESEARCH AND PRODUCTION SUPPORT DIVISION

VEGETABLES / CROPS	TIME OF PLANTING	PLANT POPULATION per HECTARE (no.)	MATURITY	VOLUME OF PRODUCTION (tons / ha.)	DISTANCE OF PLANTING Hill (cm.)	DISTANCE OF PLANTING Rows (cm)
AMPALAYA	All Season	20,000	60-75 Days After Planting (DAP)	8-15	100	150
UPO	October – March	3,333	90-100 DAP	5-10	100	300
BROCCOLI	October – December	50,000	50-65 DAP	4-10	40	50
ONION BULB	October – February	444,444	3-4 Months After Transplant	8-15	15	15
BUSH SITAO	November – March	133,333	45-50 DAP	8-10	10	75
BUSH SNAP BEAN	October – January	33,333	50 DAP	8-12	40	75

Image 5b. **Sample planting calendar sourced from DA-BPI**

4.3.2 Use of Soil Fumigants to Sterilize the Soil

4.3.2.1 The use of chemical fumigants and alternatives to sterilize soils and substrates is justified. The farm should not use banned chemical fumigants and other practices not allowed under national legislations.

Explanatory Note:

Fumigant is a chemical substance that, under specific temperature and pressure conditions, exists as a gas in sufficient concentrations to cause death to a targeted pest (USDA, 2020).

The DA-FPA issued the **list of banned and restricted chemicals** which is available at https://fpa.da.gov.ph/. Examples of banned and restricted pesticides are Dibromochloropropane (1,2-dibromo-3-chloropropane, DBCP) or DBCP, Nitrofen, and Toxaphene (DA-FPA, 2020).

Aside from chemical fumigants, non-chemical fumigation techniques are also available. These are the use of solar energy, soil sterilization (steaming technique), and soil solarization.

Soil solarization is a hydrothermal process (collects solar radiation and converts it into heat) that is usually done for moist soils. Soils are covered by polyethylene film and then exposed to direct sunlight to entirely/partially eradicate soil-borne viruses and pests. Essentially, this method is used to reduce the use of pesticides and other chemicals to control pest pathogens that are carried by the soil (Santosh *et.al.*, 2023).

Image 6. **Soil solarization**

4.4 Fertilizers and Soil Additives

4.4.1 General

4.4.1.1 To optimize nutrient use and minimize nutrient losses, the farm should apply fertilizers based on the quantitative information on soil nutrient based on soil analysis or leaf or sap analysis.

Explanatory Note:

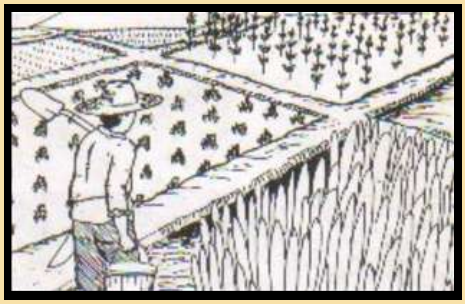
Soil analysis provides information on the nutrient levels in the soil, allowing for informed decisions on the **specific type and quantity of fertilizers required for optimal plant growth and nutrient balance** (BSWM, 2020).

Soil samples can be analyzed by the DA-BSWM or by the DA regional or provincial soil laboratories. Soil analysis report includes fertilizer recommendations for effective fertilizer use and increased crop production.

In addition, the DA-BSWM developed the following procedures for collecting soil samples for analysis:

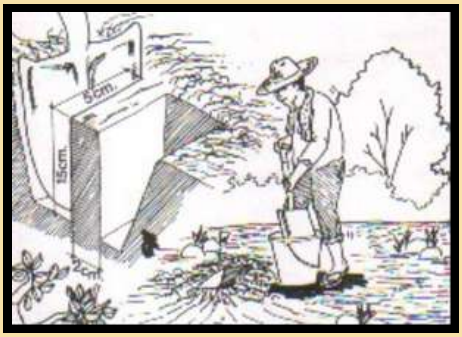
1. Prepare the following: pail, shovel, bolo, plastic, and meter stick.

2. Divide your farm according to the kind of crops grown or to be grown, the type of soil (sandy, clayey, or loamy), and topography (level, flat, sloping, or hilly). Collect soil samples from the different soil unit areas and place them in separate containers.

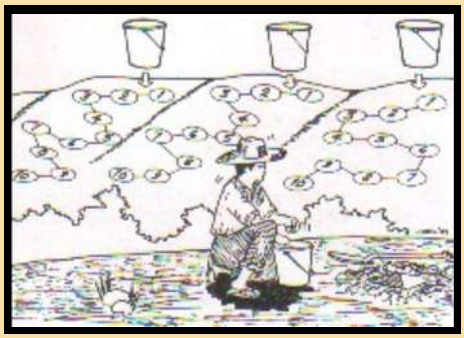


3. Brush away stone, rubbish, trash, or grass on the surface of the land.

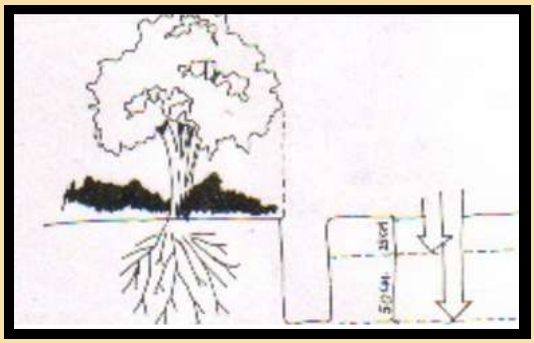
4. Push the shovel down the surface or topsoil to a depth of approximately 15 cm and get a slice of soil sample 2 cm thick and 5 cm wide. Place this in a container.



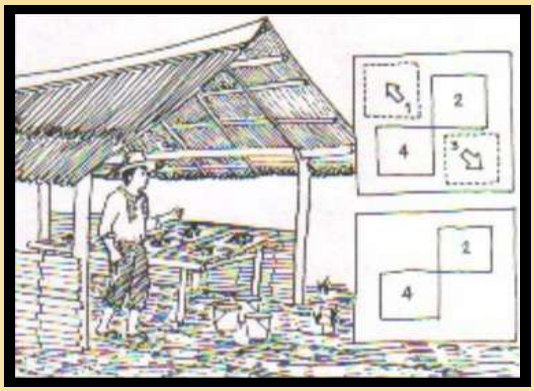
5. Get similar samples randomly from as many as ten sites and mix them in a container. Get a composite soil sample of about 1 kilo to represent the soil unit area.



6. For fruit trees, soil samples should be taken directly below the rim of the crown of the tree at 25 to 30 cm depth for fruit trees/permanent crops like coconut.

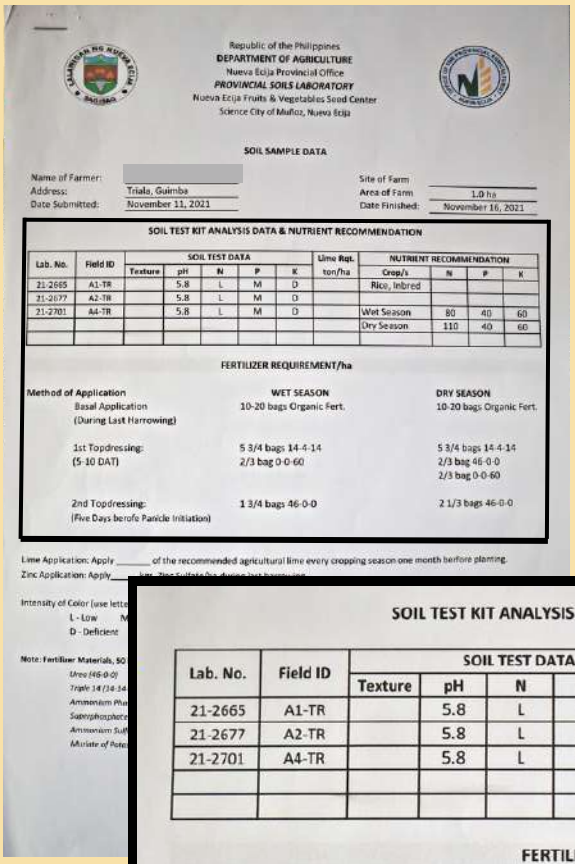


7. Air dry the soil samples by spreading them in plastic sheets or mats under the shade or indoors. Be sure to avoid contaminations among the samples and keep them away from dirt or foreign matters, especially cigarette ash. Divide representative soil samples into four. Remove soil samples 1 and 3 and retain soil samples 2 and 4 (see illustration). Repeat the process four times until you obtain one kilo.



8. When air-dried, get at least 1 kilo from each composite soil sample and place it separately in a cloth or plastic bag.

9. Label the bags properly and send them to the nearest DA Regional Analytical laboratory or analyze using a soil test kit from reliable sources like DA-BSWM.



Republic of the Philippines
DEPARTMENT OF AGRICULTURE
Nueva Ecija Provincial Office
PROVINCIAL SOILS LABORATORY
Nueva Ecija Fruits & Vegetables Seed Center
Science City of Muñoz, Nueva Ecija

SOIL SAMPLE DATA

Name of Farmer:
Address: Triala, Guimba
Date Submitted: November 11, 2021
Site of Farm
Area of Farm 1.0 ha
Date Finished: November 16, 2021

SOIL TEST KIT ANALYSIS DATA & NUTRIENT RECOMMENDATION

Lab. No.	Field ID	SOIL TEST DATA					Lime Rqt. ton/ha	NUTRIENT RECOMMENDATION			
		Texture	pH	N	P	K		Crop/s	N	P	K
21-2665	A1-TR		5.8	L	M	D		Rice, Inbred			
21-2677	A2-TR		5.8	L	M	D					
21-2701	A4-TR		5.8	L	M	D		Wet Season	80	40	60
								Dry Season	110	40	60

FERTILIZER REQUIREMENT/ha

Method of Application	WET SEASON	DRY SEASON
Basal Application (During Last Harrowing)	10-20 bags Organic Fert.	10-20 bags Organic Fert.
1st Topdressing: (5-10 DAT)	5 3/4 bags 14-4-14 2/3 bag 0-0-60	5 3/4 bags 14-4-14 2/3 bag 46-0-0 2/3 bag 0-0-60
2nd Topdressing: (Five Days berofe Panicle Initiation)	1 3/4 bags 46-0-0	2 1/3 bags 46-0-0

Lime Application: Apply _____ of the recommended agricultural lime every cropping season one month before planting.
Zinc Application: Apply

Intensity of Color (use lette
L - Low
D - Deficient

Note: Fertilizer Materials, SO
Urea (46-0-0)
Triple 14 (14-14
Ammonium Pho
Superphosphate
Ammonium Sulf
Muriate of Pota

Image 7a. **A sample copy of soil analysis report**

SOIL TEST KIT ANALYSIS DATA & NUTRIENT RECOMMENDATION

Lab. No.	Field ID	SOIL TEST DATA					Lime Rqt. ton/ha	NUTRIENT RECOMMENDATION			
		Texture	pH	N	P	K		Crop/s	N	P	K
21-2665	A1-TR		5.8	L	M	D		Rice, Inbred			
21-2677	A2-TR		5.8	L	M	D					
21-2701	A4-TR		5.8	L	M	D		Wet Season	80	40	60
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Source: BSWM, n.d

Image 7b. **A sample of a soil test kit**

Always remember to follow the specific instructions provided with the soil test kit, as different kits may have variations in procedures and interpretations.

If there are specific questions or if there is a need for more detailed recommendations, consider consulting agricultural extension workers or any technical experts.

4.4.1.2 Fertilizers and soil additives should be judiciously selected to minimize the risk of contamination of produce, particularly with the heavy metals. Only duly registered fertilizers (inorganic and bio/organic) should be used.

Explanatory Note:

Registration of commercial fertilizers is a requirement by the DA-FPA, which includes heavy metal analysis. The registration number of registered commercial fertilizer and organic soil amendment (OSA) is indicated in the packaging material. An example is shown below.

Image 8a . **Fertilizer duly registered with FPA Registration Number**

On the other hand, the registration of OSA is managed by the DA-BAFS. Organic fertilizers can be either supplementary or self-produced. Supplementary organic fertilizers are obtained from sources outside the farm, while self-produced organic fertilizers should comply with the guidelines stated in Section 4.6.4 of the *PNS Organic Crop Production, Postharvest and Processing - Code of Practice (PNS/BAFS 337:2022).*

To verify the authenticity of certified organic fertilizers, refer to the list issued by the Bureau of Agriculture and Fisheries Standards (BAFS) at www.bafs.da.gov.ph.

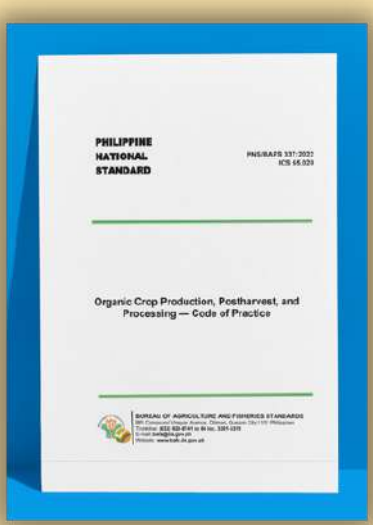


Image 8b .**Cover page of PNS/BAFS 337: 2022**

4.4.1.3 The risk of chemical and biological contamination of produce from the use of fertilizers or soil additives is assessed for each crop grown and a record is kept of any significant hazards identified.

Explanatory Note:

Contamination can occur either directly or indirectly. During the assessment of contamination from the use of fertilizers or soil additives, the following are important considerations:

1. direct contamination between the substance and the crop's edible portion happens **during soil or foliar application;**
2. indirect contamination happens through **contaminated soil or water;**
3. risk of chemical contamination from **unregistered fertilizers and soil additives, improper use of fertilizer;**
4. **crops grown at or near ground level carry a higher risk of contamination** compared to those cultivated above the ground
5. biological contamination can occur when **untreated animal manure or improperly composted materials are used**. These materials are untreated animal manure or improperly composted materials (ASEAN, 2006).

Upon confirmation of the presence of contaminants, corrective actions can be implemented based on the identified source of the contamination. For guidance in identifying sources of contamination and implementing corrective measures, the DA-RFO Regulatory Division or the LGU MAO may be tapped.

4.4.1.4 In the case that potting mix (e.g., coco peat, peat moss, rice hull, compost) is used in the farm, the name of the source or supplier should be documented.

4.4.1.5 For hydroponic production systems, the mixing, application and disposal of the nutrient solution is monitored and recorded.

Explanatory Note:

Monitoring and recording of mixing and application of nutrient solution aim to verify that these activities are done following the recommendation. The surplus nutrient solution or used nutrient solution is applied as liquid fertilizer for other crops and is not disposed of in waterways (Santos & Ocampo, 2005).

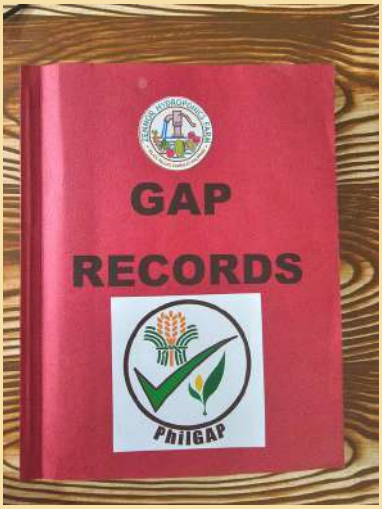
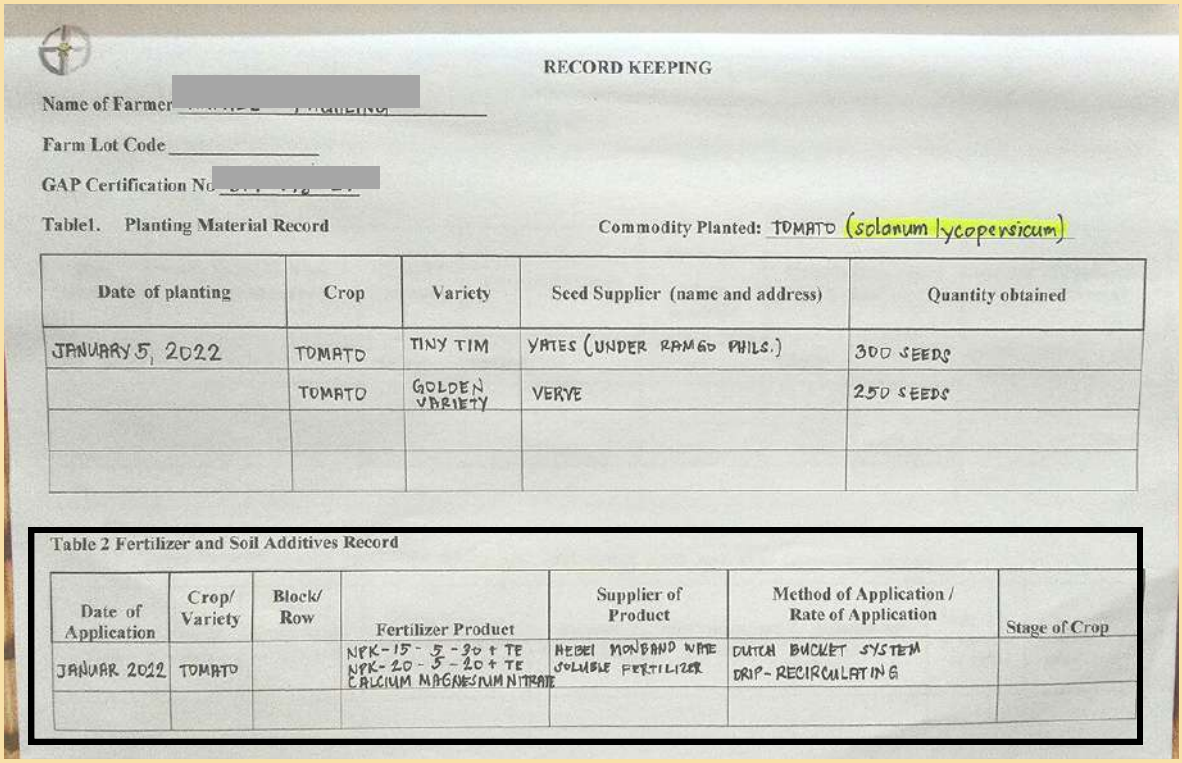


Image 9a. **A dedicated records notebook for farm activities**



RECORD KEEPING

Name of Farmer [redacted]

Farm Lot Code _____

GAP Certification No [redacted]

Table1. Planting Material Record

Commodity Planted: TOMATO (solanum lycopersicum)

Date of planting	Crop	Variety	Seed Supplier (name and address)	Quantity obtained
JANUARY 5, 2022	TOMATO	TINY TIM	YATES (UNDER RAMGO PHILS.)	300 SEEDS
	TOMATO	GOLDEN VARIETY	VERVE	250 SEEDS

Table 2 Fertilizer and Soil Additives Record

Date of Application	Crop/ Variety	Block/ Row	Fertilizer Product	Supplier of Product	Method of Application / Rate of Application	Stage of Crop
JANUAR 2022	TOMATO		NPK-15-5-30+TE NPK-20-5-20+TE CALCIUM MAGNESIUM NITRATE	HEBEI MONBAND WATER SOLUBLE FERTILIZER	DUTCH BUCKET SYSTEM DRIP-RECIRCULATING	

Image 9b. **Sample record of a hydroponic production system**

Image 9c. **Sample of hydroponic system for reference**

Image 9d. **Lettuce and bell peppers are being grown using Simple Nutrient Addition Program (SNAP) hydroponics**

4.4.2 Organic Fertilizer

4.4.2.1 Composting areas should be separated from the crop production area and from drinking and farm water sources.

Explanatory Note:

Separating the composting area from the crop production area and water sources aims to prevent contamination. The composting area is separated by strategically situating it from the production area and water sources. Other measures include covering the composting area and installing proper drainage.

Image 10a. **Sample composting area of a large farm with signage**

Although not a mandatory requirement, posting detailed internal recommended procedures can help in performing farm activities appropriately.

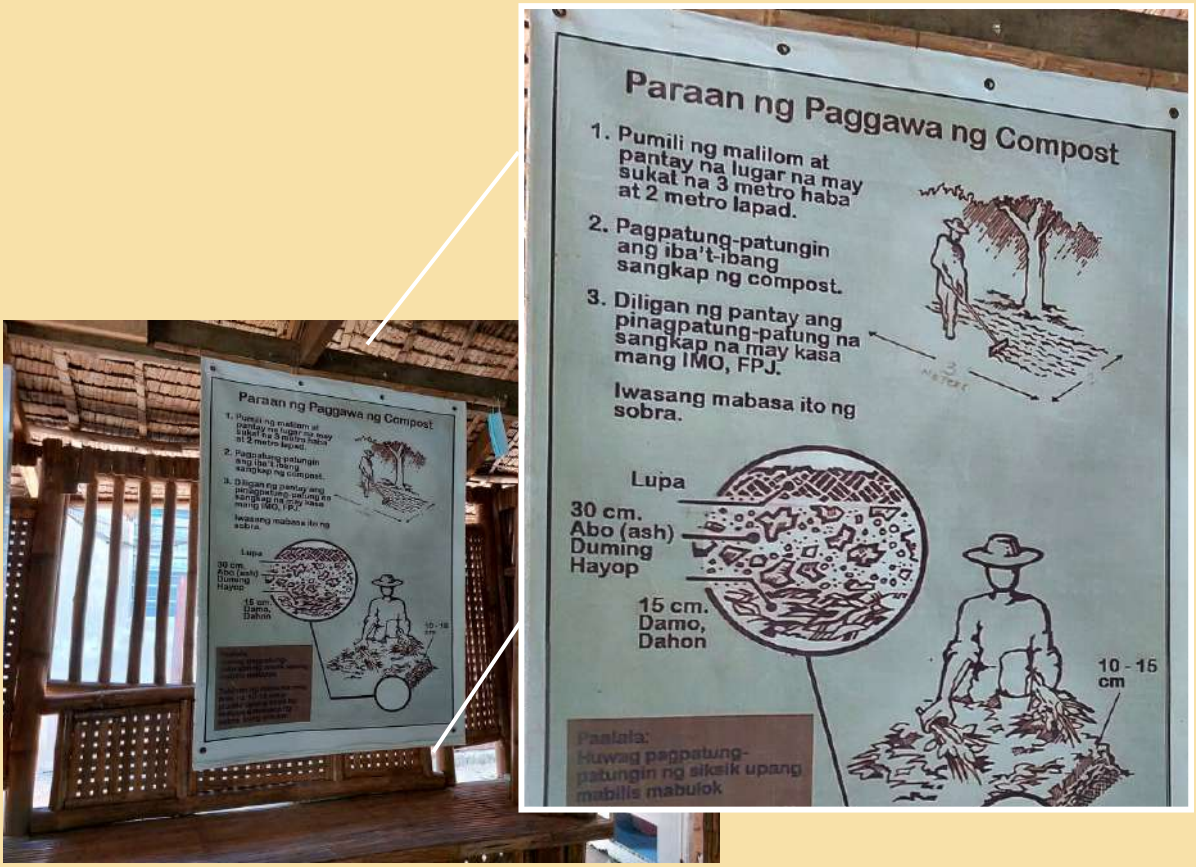


Image 10b. **Inside of a composting area with recommended procedure of composting**

4.4.2.2 Undecomposed (untreated) organic materials must not be applied because the presence of potential contaminants may affect the produce. Organic fertilizer materials should be treated prior to application.

Explanatory Note:

Untreated animal manure or improperly composted materials may contain higher levels of pathogenic microorganisms (ASEAN, 2006). When using organic fertilizer, the *PNS Organic Crop Production, Postharvest, and Processing — Code of Practice (PNS/BAFS 337:2022)* states that:

> *When the supplementary application of organic fertilizer is needed, the materials shall be certified as organic in conformance with the requirements of the PNS/BAFS 183:2020 (Organic soil amendments).*

In addition, below are the key provisions from the *PNS Code of Practice for the Production Organic Soil Amendment (PNS/BAFS 291:2019)* relevant to the treatment of organic fertilizer before application.

Solid organic fertilizer and compost/soil conditioner
Single or a combination of raw materials should undergo a proper decomposition process to reach a minimum of 60°C to destroy pathogenic microorganisms.

Liquid organic fertilizer and organic plant supplement
Heavy metal-contaminated raw materials should be avoided in the production of liquid organic fertilizer and organic plant supplements. Liquid organic fertilizer and organic plant supplements should undergo a complete fermentation process followed by proper handling and aeration.

Microbial inoculant
The carrier should be able to sustain a high population of the inoculum strain during the storage period. This can be done through sterilization of the carrier material. Carriers for seed or soil inoculation may be prepared from various types of materials.

The *PNS Code of Practice for the Production Organic Soil Amendment (PNS/BAFS 291:2019)* is available for download at the DA-BAFS website at www.bafs.da.gov.ph.

Image 11. **Cover page of PNS/BAFS 291:2019**

4.4.2.3 Production procedures, such as: composting, solarization, heat drying, etc., should be designed to reduce or eliminate pathogens in manure, biosolids and other natural fertilizers.

4.4.3 Human Sewage

4.4.3.1 Human sewage whether processed or unprocessed must not be used for production of fresh fruits and vegetables.

Explanatory Note:

Human waste can potentially contain pathogenic microorganisms and is not suitable for cultivating fresh produce (ASEAN, 2006).

Fecal matter is a major component of sewage and is a source of the majority of pathogenic microorganisms in wastewater (Symonds & Breitbart, 2014). Moreover, predominant bacterial pathogens found in wastewater of human origin include *Salmonella spp.*, *Escherichia spp.*, *Shigella spp.*, *Yersinia spp.*, *Klebsiella spp.*, *Leptospira spp.*, *Vibrio cholerae*, *Aeromonas hydrophila*, *Legionella pneumophila*, *Mycobacterium spp.*, and *Pseudomonas* (Cai & Zhang, 2013).

4.4.4 Equipment Maintenance

4.4.4.1 Equipment used for the application of fertilizers and soil additives should be maintained in good working condition and should be checked regularly by a technically competent person.

Explanatory Note:

Proper equipment operation ensures precise fertilization and soil additive application. To maintain accuracy, the equipment is inspected at least annually by a qualified individual. This individual may include the farmer, skilled operators, or equipment supplier representatives (ASEAN, 2006).

The DA RFO and DA-BAFE can provide technical assistance in checking equipment for fertilizer and soil additive application.

4.4.5 Storage Facility and Management

4.4.5.1 Areas or facilities for storage, mixing and loading of fertilizers and soil additives and for composting of organic materials should be constructed as far away as possible from the water source. These facilities should be properly maintained to minimize the risk of contamination of production areas and water sources.

Explanatory Note:

Storing fertilizers and soil additives near water sources can lead to contamination through accidental spillage. It is also good to consider that areas or facilities for storage, mixing, and loading of fertilizers and soil additives are protected from potential theft, unauthorized access by untrained individuals, and extreme temperatures (Bauder et al., n.d.).

Image 12. **Secured area for fertilizers and soil additives located away from water source**

4.4.5.2. For the storage of fertilizer materials:

a) Storage area must be separated from other agro-chemical products to prevent cross contamination;

Explanatory Note:

Separation of storage area for fertilizer materials from other agrochemicals can prevent cross-contamination, including unintended mixing of different substances.

b) The storage area should be well-ventilated and appropriately covered to protect inorganic fertilizers, such as powder, granules or liquids from sunlight, rain, humidity, and other atmospheric factors;

Explanatory Note:

A well-ventilated storage area can help prevent the accumulation of fumes. Further, an appropriately covered storage area can help prevent the degradation or loss of effectiveness of fertilizers.

Image 13. **Well-ventilated storage area for fertilizer**

c) Storage area should be free from waste, does not constitute a breeding place for rodents, and where spillage and leakage are easily cleared away;

Explanatory Note:

A clean and well-maintained storage area does not harbor pests, thus, reducing the risk of contamination.

Image 14. **Fertilizers properly placed in plastic pallets in a separate storage area**

d) All inorganic fertilizers should be stored in a prescribed manner to avoid or minimize the risk of contamination of water sources. For instance, liquid fertilizers must be bunded and proximity of water sourses and flood risks, etc. should be considered; and

Explanatory Note:

A simple wooden pallet as seen in images 13 and 14 can serve as an ideal dunnage to prevent fertilizer from becoming wet on a damp floor and to protect the bags from ground humidity (FPA, n.d.).

e) Fertilizers should not be stored with harvested crop or yield and plant propagation materials.

4.4.5.3 The utilization of inorganic fertilizer should observe First-In First-Out practice (FIFO).

Explanatory Note:

The FIFO method is an inventory management approach that helps determine which of the fertilizer stocks should be used, sold, or disposed of first. In implementing FIFO in the fertilizer inventory management system, the fertilizers are labeled upon storage and the newly received fertilizer stocks are placed behind the older stocks to facilitate movement and stock rotation.

4.4.6 Disposal of Left-Over Fertilizers, Used Nutrient Solutions and Containers

4.4.6.1 Leftover fertilizers and unused nutrient solutions, if any, should be properly disposed.

Explanatory Note:

Fertilizers are prepared and applied based on the volume requirement. By doing this, excess fertilizer solution is avoided. Disposal of surplus fertilizer solution considers its effect on the environment and possible contamination of waterways.

4.4.6.2 Used inorganic fertilizer containers should be disposed according to approved label recommendations.

4.5 Water

4.5.1 Source of Irrigation Water

4.5.1.1 The risk of chemical or biological contamination of produce from the water used for irrigation, fertigation, application of chemicals, washing, treatments, cleaning, sanitation and other forms of handling the produce should be assessed. Particular attention should be given especially for those crops that are grown close to the ground. Moreover, the proximity of water sources on possible sources of contamination (e.g., near the dumping site, near septic tanks, etc.) should be considered during assessment.

Explanatory Note:

Produce that is grown in or close to the ground has a higher risk of contamination than those grown well above the ground because contamination because they is more exposed to various sources of potential contamination. Contaminants may come from the soil, water, or other environmental factors, and proximity to the ground increases the likelihood of direct contact (ASEAN, 2006).

Contamination of water sources can occur through chemical spills or runoff from adjacent sites. Some pathogenic organisms like *Salmonella*, and *E. coli*, parasites such as *Cryptosporidium*, *Giardia*, and *Cyclospora*, and viruses such as Hepatitis A virus and the Norwalk virus, can be present in the water. Aside from the examples enumerated in Section 4.5.1.1, potential sources of contamination also include animal grazing near water sources, uncontrolled access to livestock, and inappropriate storage of manure (ASEAN, 2006).

Water used in farm operations is typically sourced from waterways like rivers and streams, lakes, reservoirs, dams, bores, and storage tanks. These water sources can be contaminated by microorganisms or chemicals.

Water sourced from **waterways** might carry microorganisms if it flows in areas with livestock activities like feedlots, dairies, and piggeries, as well as areas with high human populations. Chemical contamination may also occur near industrial or agricultural zones that release chemicals into water sources.

Dams can be susceptible to microorganism contamination due to surface runoff and entry of livestock or birds. Chemical contamination may also occur if chemical storage or areas for spray rig washing and filling are near the dam or waterway as well as pesticide spillage and improper disposal of sprayer washing.

Bores might encounter microorganism contamination through seepage from septic systems or runoff from heavily grazed catchment areas.

Water storage tanks and pipes, often used for collecting rainfall, can be affected by microorganism contamination from birds, rodents, or animal feces on the roof and gutters where water is collected. Dead birds, rodents, and animals in gutters or tanks can also contribute to contamination (ASEAN, 2006).

Source: BPI, n.d.

Image 15. **Covered water source far from possible sources of contamination**

4.5.1.2 Where water testing is required to assess the risk of contamination, tests should be conducted at a frequency appropriate to the degree of potential risk from the water supply.

Explanatory Note:

When conducting water testing to ensure the safety of produce, it is important to sample the water at the point where it comes into contact with the produce. It is also advisable to take samples during times when the likelihood of contamination is highest. While it may not be practical to test the water for every possible pathogenic microorganism, **a general rule is to test the water when the source conditions change**. For instance, water sourced from dams and waterways is more susceptible to contamination from runoff after rainfall than water from deep underground bores.

When it comes to testing water for chemical contaminants, it is usually only necessary if there is suspicion of chemical contamination. For example, if chemicals are spilled into waterways used for washing produce near the farm, it is essential to test the water for chemical contamination (ASEAN, 2006).

4.5.1.3 Where the risk of chemical and biological contamination of produce is significant, an alternative water source should be developed or necessary water treatment should be done.

Explanatory Note:

In general, the quality of water that comes in direct contact with the edible portion of produce needs to be of better quality compared to other uses where there is minimal contact (FAO, 2009).

According to FAO (2009), sources of freshwater include precipitation, surface water (e.g. lakes, rivers, ponds), groundwater (e.g. springs), wetlands, and reservoirs.

The following are the various types of water, indicating the factors that can contribute to its likely contamination. These may guide in identifying alternative water sources.

1. **Groundwater** is less likely to be contaminated with pathogens.

2. **Surface waters from rivers, streams, and irrigation canals** are most likely to be contaminated. Creeks and rivers may be contaminated with microorganisms if it is located near livestock feedlots, piggeries, or in highly-populated areas.

3. **Shallow wells and improperly constructed or older wells** may be under the influence of surface water meaning they receive direct recharge from nearby surface water bodies or lakes. Shallow wells that are under the influence of surface water are more susceptible to contamination since run-off from surface, pollutants and changes in surface water quality can affect the well water quality. Although these shallow wells that are under the influence of surface water provide a reliable water source, diligent monitoring and protection of the well construction is needed to ensure water quality and safety.

4. **Artificial water sources** are also prone to contamination.
   - For **dams**, contamination can come from microorganisms from surface runoff or entry of bird life or livestock and pets;
   - For **pumps**, microorganisms from seepage from septic systems or heavily grazed catchment areas; and
   - For **rainwater tanks**, contamination is due to birds, rodents, or animal feces in the gutters or tanks.

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   - For **rainwater tanks,** contamination is due to birds, rodents, or animal feces in the gutters or tanks.

Water Treatment

If water treatment is necessary, various chemical and non-chemical sanitizing methods can be used to address biological contamination. However, it is crucial to ensure that the sanitizing agents are approved or registered for use by a competent authority.

It is also recommended to seek technical advice from a competent authority to determine the best option for the targeted microorganism. The following are **common options for water treatment**:

1. Chlorine;
2. Chlorine dioxide;
3. Chloro-bromine compounds;
4. Hydrogen peroxide;
5. Peracetic acid;
6. Peroxy compounds (combinations of hydrogen peroxide and peracetic acid);
7. Ozone; and
8. Ultraviolet light.

It is also important to check if water treatment is effective by monitoring its sanitation. The monitoring approach depends on the treatment method. For instance, if chlorine is used, it's necessary to regularly check the water's pH, as chlorine is less effective when the pH is above 7.5. Also, organic matter in the water can make chlorine less active. Regular monitoring with test strips is needed to ensure that free chlorine is present (ASEAN, 2006).

4.5.2 Suitability of Water Quality for Agricultural Production

4.5.2.1 Irrigation use is based on crop water requirements, water availability, soil moisture levels, and consideration of environmental impact on and off the site. Water used for agricultural purposes should be of suitable quality for its intended use.

4.5.3 Quality of Water Used for Fertilizer and Pesticide Application

4.5.3.1 Water used for the application of water-soluble fertilizers and agricultural chemicals in the field or indoor growing facility should not contain microbial, chemical and physical contaminants at levels that may adversely affect the safety of fresh fruits and vegetables.

4.5.4 Efficiency Use and Management of Water

4.5.4.1 Water collection, storage, delivery and use should be managed.

4.5.4.2 The irrigation system is checked for operational efficiency during each use according to operator's instructions or other appropriate methods and maintained to ensure efficient delivery.

4.5.4.3 Water from toilets and drainage systems are disposed of in a manner that minimizes the risk of health and environmental harm on and off the site.

Explanatory Note:

The disposal of water from toilets and drainage systems is a critical component of sanitation on the farm as it has an impact on both health and the environment. The following measures minimize health hazards and environmental degradation due to improper disposal of water from toilets and drainage systems:

1. construction of septic tank;
2. disposal of waste from mobile toilets away from the production area and waterways; and
3. proper maintenance of drainage systems to minimize the risk of flooding and environmental degradation due to stagnant water (Blom, 2015).

4.5.4.4 Water used from sources that may cause environmental harm to the land and soil, waterways and sensitive areas should be managed or treated to minimize the risk of health and environmental harm.

Explanatory Note:

Management of water used from sources that may pose risks is essential to protect land, soil, waterways, and sensitive areas. To minimize the risk, the following

measures may be considered:

- construction of a water containment facility,
- application of water remediation measures (e.g. use of water lily, kangkong, layers of rocks, sand, and charcoal as filters), and
- carry out water disinfection to remove contaminants and pathogens from the water.

Water conservation practices may also reduce the overall demand of the farm for water, thus, lessening environmental harm in the long run. Furthermore, regular monitoring of water quality and reporting of any incidences that could lead to environmental harm to the appropriate authority.

4.5.5 Untreated Sewage Water

4.5.5.1 Untreated sewage water should not be used for irrigation or fertigation. Whenever treated sewage water is used, water quality should comply with the WHO 1989 published Guidelines for the Safe Use of Wastewater and Excreta in Agriculture and Aquaculture, or the country's guidelines on the matter which is the Department of Environment and Natural Resources (DENR) Clean Water Act, specifically on use of waste water. Otherwise, untreated sewage water should not be used during production and postharvest handling of produce.

Explanatory Note:

Untreated sewage water can contain harmful pathogens, chemicals, and other contaminants that pose significant risks to consumers and agricultural workers. The same is true for reclaimed sewage water. This type of water may carry pathogenic microorganisms (ASEAN, 2006).

Whenever treated sewage water is used, reference can be made to the PNS Wastewater Re-use for Irrigation (PNS/BAFS/PAES 232:2017) that provides quality limits and prescribed quantity of wastewater to be reused for irrigation.

Image 16. **Cover page of PNS/BAFS/PAES 232:2017**

Section 10 Precautionary Measures of PNS/BAFS/PAES 232:2017 states the following precautionary measures:

1. Direct contact with wastewater shall be avoided.
2. Use of fine mist for sprinkler irrigation shall be avoided to minimize the risk of aerosol dispersion by wind drift.
3. Potable and wastewater lines shall not cross-connect. Wastewater pipeline shall be installed far enough from a parallel potable water pipeline.
4. Storage facilities shall be designed such that seepage is prevented and freeboard is adequate.
5. Irrigation with wastewater shall be stopped immediately when algal bloom occurs.

4.6 Crop Protection

4.6.1 Choice of Crop Protection Products

4.6.1.1 Crop protection measures should be appropriate for the control of pests and based on the approval of the competent authority.

4.6.1.2 Growers should use agricultural chemicals that are registered for the cultivation of the specific fruit or vegetable and procured from licensed suppliers and approved by the competent authority in the country where the crop is grown and in the country where the produce is intended to be traded. The use of such agricultural chemicals must be in accordance with the approved label instructions for the intended purpose/s.

Explanatory Note:

It is important to emphasize that **crop protection products are typically crop-specific.** When a pesticide undergoes the registration process with the DA-FPA, it is evaluated/assessed for its efficacy and safety for use on a specific commodity.

Based on the DA-FPA Pesticide Regulatory Policies and Implementing Guidelines (2020), FPA-registered crop protection products are also required to put on the label:

> *A general statement summarizing the use of the product shall be placed as near as possible to the trade name, (e.g., FOR CONTROL OF POST-EMERGENCE ANNUAL BROADLEAF WEEDS IN RICE). The statement shall draw the user's attention to the crops on which the pesticide is registered and can be used.*

In addition, the DA-FPA Pesticide Regulatory Policies and Implementing Guidelines (2020) requires pesticide labels to also contain the following information:

1. Product information
    - Name and Ingredient Statement
    - Solvent Statement
    - A general statement summarizing the use of the product shall be placed as near as possible to the trade name
    - The net weight or volume (in metric units) of the product in the container
    - Name and address of manufacturer, distributor, or agent
    - The DA-FPA registration number and the phrase REGISTERED WITH THE FERTILIZER AND PESTICIDE AUTHORITY PURSUANT TO P.D. 1144
    - Shelf-life of the pesticide product
    - Identification number of manufacturing lot or batch
    - Product Mode of Action
2. Directions for use
3. Directions for storage and disposal
4. Safety precautions
5. First aid, information for Physicians, and treatment
6. Prohibition/Warranty statements

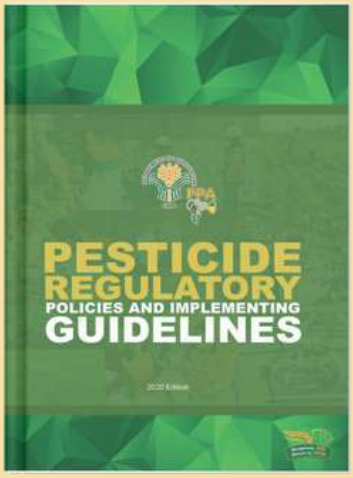


Image 17. **Cover page of the DA-FPA "Greenbook"**

The 'Directions for use' in the label include information on what pest the pesticide will be used against, application rates, timing, and precautions to ensure effective and safe use. Thus, it is recommended to always check the label of the crop protection product to ensure that it is registered for use on the crop it will be applied.

Knowing the information provided above can assist growers in how to select and use agricultural chemicals effectively.

4.6.1.3 If the choice of chemical products is made by advisers, proof of their technical competence should be made available such as certificates of trainings, education, experience and accreditation from competent authority.

4.6.1.4 The expiry dates of the chemicals to be procured should be considered. The expiration date is 2 years after the formulation date indicated on the label.

Explanatory Note:

Pesticide shelf-life is the period that a pesticide can be stored before its effectiveness, stability, and safety deteriorates. The shelf-life of pesticides, however, will be shortened if pesticides are not stored properly (e.g. if they are stored at high temperatures) (Satyavani, et al., 2012).

Source: CropLife, n.d.

Image 18. **Pesticide container indicating the date of expiry for reference**

4.6.1.5 These should be applied at approved dosages to prevent residue levels exceeding the maximum residue limits (MRLs).

Explanatory Note:

In determining the applicable standards for pesticide MRL, the following can serve as references:

1. national/domestic MRL available in applicable PNS MRL;
2. In the absence of PNS MRL, Codex Pesticide MRL can be a reference;
3. In the absence of PNS MRL and Codex Pesticide MRL, ASEAN Pesticide MRL can serve as a reference; and
4. In the absence of PNS, Codex, and ASEAN MRL:
    - the applicable recommended MRL of pesticides registered by the Fertilizer and Pesticide Authority (FPA) can serve as provisional MRL, subject to evaluation by the competent authority.
    - the applicable pesticide MRL of the exporting country, registered by the Fertilizer and Pesticide Authority (FPA), can serve as a provisional MRL, subject to evaluation by the competent authority

To ensure up-to-date information on the applicable MRL, it is advisable to consult the DA-BPI.

4.6.1.6 The produce shall be subjected to residue analyses to be conducted by an accredited laboratory.

Explanatory Note:

The DA-BPI Plant Product Safety Division (PPSSD) provides laboratory services for pesticide residue analysis. The BPI-PPSSD has a central laboratory located in Diliman, Quezon City. The Satellite Pesticide Analytical Laboratories (SPAL) are in Baguio, Cebu, Cagayan de Oro City, and Davao.

It is advisable to always check the DA-BPI website or contact their office for any specific requirements or fees for the residue analysis on the contact information below.

BPI PPSSD Pesticide Analytical Laboratory Section
Address: Visayas Ave, Diliman, Quezon City
Contact number: 8-426-3366; 8-461-1622
Email address: lsdnpal2010@gmail.com

SPAL Baguio
Address:
Contact number: 8-426-3366; 8-461-1622
Email address: lsdnpal2010@gmail.com

SPAL Cebu
Address: Estancia, Mandaue City, Cebu
Contact number: 8-426-3366; 8-461-1622
Email address: lsdnpal2010@gmail.com

SPAL Cagayan de Oro
Address: Pacana street, Cagayan De Oro, Mismais Oriental
Contact number: (088)880-52-42
Email address:

SPAL Davao
Address: Bago Oshiro, Tug buk District, Davao City
Contact number: (082)293-0108
Email address: bpipal@yahoo.com

4.6.1.7 Up to date information on chemical MRL standards for the country where produce is intended to be traded, is available from a competent authority.

4.6.1.8 If chemical residues in excess of the MRL are detected in the country where produce is traded, marketing of the produce is ceased. The cause of the contamination is investigated, corrective actions are taken to prevent re-occurrence, and a record is kept of the incident and actions taken.

4.6.2 Mixing of Crop Protection Products

4.6.2.1 The mixing area should be located and chosen in such a way that the risk of contaminating the workers and the environment are minimized.

Explanatory Note:

The location of the mixing area considers its proximity to water bodies and flooding to minimize the risk of contaminating the environment. Likewise, the mixing area considers the foot traffic of workers to minimize their exposure to chemical fumes.

Image 19. **Mixing area located away from the production area and water sources**

4.6.2.2 Mixing of agricultural chemicals should be carried out in a manner that will prevent ground and surface water contamination and the land in the surrounding areas.

4.6.2.3 The filling and mixing areas for the crop protection product should be equipped with appropriate tools for precise measurements and calibrations. The functionality of such should be checked before every cropping season by the grower/applicator. The filling and mixing areas should have floor brush, dustpan, plastic bags and adsorbent materials such as sand. These materials should be placed in a fixed location within the specific area, to be used in case of spillage of cop protection product.

Explanatory Note:

Source: DA-BPI, n.d.

Image 20a. **Charcoal, sand, and sawdust as absorbent materials in the cleanup of certain types of chemical spills**

Source: DA-RFO CAR, n.d.

Image 20b. **Dustpan for containment and sweeping of chemical spills**

4.6.2.4 Emergency facilities in the event of accidental spill during mixing should be readily available.

Explanatory Note:

Aside from floor brush, dustpan, plastic bags and adsorbent materials emergency, facilities such as eye wash and shower safety are samples of equipment designed to address specific hazards, particularly those involving exposure to hazardous chemicals.

Source: Canva, n.d.

Image 21. **Eye wash and shower facility in case of emergency**

In situations **where there may be limited resources and in the event of a chemical splash to the eyes, a lavatory equipped with running water can function as an improvised emergency eye-flushing station.** However, it is essential to **exercise caution and prioritize seeking professional assistance for optimal care.**

Image 22. **Improvised emergency facility (wash area) in case of accidental spill**

In addition, basic personal protective equipment such as gloves and goggles can provide some protection during minor spills. Attending training sessions on potential hazards, safe handling practices, and emergency procedures is crucial for accident prevention and ensuring appropriate responses.

4.6.2.5 If a chemical is transferred to another container, the new container should be clearly marked with the brand name, concentration of active ingredient, details of the prepared solution (if applicable), rate of use, and withholding period or Preharvest Interval (PHI). Prepare only the necessary volume of spray solution to avoid surplus application mix.

4.6.2.6 Surplus application mixes are disposed of in a manner that does not present a risk of contaminating the produce.

Explanatory Note:

The surplus application mix can be sprayed in another production area where the same crop has not yet been treated, ensuring that proper measures are taken to prevent any risk of contaminating the produce.

4.6.3 Application of Crop Protection Products

4.6.3.1 The person responsible for application should be technically competent. He should possess the relevant trainings and experience, education or preferably be duly accredited as such by a competent authority (e.g. DA-FPA).

Explanatory Note:

The DA-ATI, DA-RFO, and most often companies involved in the manufacture and sales of agricultural inputs provide training on the proper application of pesticides.

The DA-FPA implements and regularly updates its *Guidelines in the Training and Accreditation of Agricultural Certified Pesticide Applicators (CPA) - Fumigator and Exterminator*. By definition,

- a CPA is a person who has attended the required training, passed the DA-FPA licensure examination, and is accredited as an individual with the capacity to safely manage the handling of pesticides;
- an exterminator is a CPA who uses liquid and powder forms of pesticides in the control treatment of agricultural pests and diseases; and
- a fumigator is a CPA who uses gaseous pesticides or fumigants in the control/treatment of agricultural pests (FPA, 2019).

It is advisable to always check the DA-FPA website for more information or contact them through the information below:

Fertilizer and Pesticide Authority
FPA Building, Bureau of Animal Industry Compound, Diliman, Quezon City
Pesticide Regulations Division : (02) 8922-3368

4.6.3.2 The Integrated Pesticide Management (IPM) principles and techniques should be used whenever possible to minimize the use of pesticides. A rotation strategy for chemical application and other crop protection measures should be employed to avoid the development of pest resistance, i.e., use different chemical groupings (e.g., organophosphates, synthetic pyrethroids, carbamates, etc.) of pesticides.

Explanatory Note:

IPM involves a **careful evaluation of various pest control methods and the integration of suitable measures that discourage the development of pest population growth.** It combines biological (e.g., use of resistant varieties and biological control agents), chemical (e.g., pheromones), physical (e.g., removal of pest and breeding sites), and crop-specific (cultural) techniques (e.g., crop rotation, planting of trap crops) to grow healthy crops and limit pesticide usage. **This approach aims to decrease the reliance on pesticides, thus minimizing potential health and environmental risks** (FAO, n.d.).

The following basic steps can be considered for an IPM approach:

1. **Prevent or suppress harmful organism** which can be done through:
   - crop rotation or intercropping;
   - use of adequate cultivation techniques like conservation tillage, pruning, and direct sowing, if applicable;
   - where appropriate, use of pest-resistant or tolerant cultivars and registered seed and planting material;
   - implementation of the recommended soil fertilization and water management;
   - prevention of the spread of harmful organisms through field sanitation and hygiene measures such as the removal of affected plants or plant parts, regular cleansing of machinery and equipment; and
   - protection and enhancement of important beneficial organisms through the utilization of ecological infrastructures inside and outside production sites.
2. **Monitor harmful organisms** with adequate methods and tools.
3. **Use pest management inputs based on the results of monitoring**. Priority is given to sustainable biological, physical, and other non-chemical methods.
4. **Apply pesticides only when threshold values indicate that the use of pesticides is justified**. Choose pesticides as specific as possible for the target pest, with the least side effects on human health, non-target organisms, and the environment.
5. **Monitor and evaluate the progress** of the applied pest management measures (FAO, n.d.).

4.6.3.3 The tank mixing of more than two (2) chemicals should be avoided, unless recommended by DA-FPA, or specified in the product label.

Explanatory Note:

Mixing of chemicals can cause chemical reactions that may affect the active ingredients, can reduce effectiveness, can even lead to crop damage, and lead to excessive MRLs in the produce (ASEAN, 2006 modified).

4.6.3.4 Growers/applicators should observe established Pre-Harvest Intervals (PHIs) or the period between chemical application and harvest.

Explanatory Note:

The pre-harvest interval (PHI), as specified on a pesticide label, designates the duration after pesticide application during which a crop must remain in the production area (Stone, 2017), or the period that must pass before the crop can be harvested after pesticide application (Peter, et. al., 2023).

Harvesting below the PHI can result in pesticide residue level above the allowed MRL.

4.6.3.5 Appropriate warning signs should be placed on a newly applied or is being applied area.

Explanatory Note:

Placing appropriate warning signs will alert individuals to the potential dangers associated with the applied substances used such as pesticides, or any other chemicals used in the farm. Warning signs help prevent unintentional exposure or contact, promoting safety for workers, and visitors.

Image 23. **Sample warning signs after pesticide application**

4.6.3.6 Workers should use well-maintained protective clothing during applications and observe established Re-entry Periods.

Explanatory Note:

The re-entry period is an important safety consideration to avoid workers' exposure to pesticide residues that might still be present on crops, surfaces, or in the air after an application. The specific re-entry period can vary based on the following factors:

- type of pesticide used;
- application method;
- crop or area treated; and
- local regulations.

The re-entry period is usually indicated on the pesticide label.

Protective clothing that is in good condition safeguards the workers from potential hazards.

Image 24. **Personnel wearing appropriate protective clothing during application of crop protection products**

4.6.3.7 Ground or aerial application of chemicals should be managed appropriately to minimize the risk of spray drift to neighboring properties and environmentally sensitive areas. In such cases, areas applied with pesticides should be marked with appropriate warning signs for public safety.

Explanatory Note:

During ground or aerial application of agricultural chemicals, warning signs provide appropriate information on the ongoing farm operation and guide the workers including the public to ensure their safety.

The spray during pesticide applications has the potential to expose individuals, plants, animals, and the environment to pesticide residues, leading to health issues, environmental impacts, and property damage.

Drift is the unintended airborne movement of pesticides to non-target areas, typically occurring during or shortly after application. Drift can occur in all forms of pesticide application such as using agricultural airplanes, ground sprayers, airblast sprayers, or irrigation systems. In general, drift can be influenced by factors in one of these four categories:

- Spray solution characteristics
- Weather
- Application equipment
- Applicator decisions

Understanding the factors influencing drift to identify the appropriate solutions to minimize potential drift problems (Fishel and Ferrell, n.d.).

4.6.4 Safety and Welfare of Authorized Worker/s During Application

4.6.4.1 Authorized farm workers should be trained on the proper handling (e.g. application) of crop protection products.

Explanatory Note:

Proper handling of crop protection products is included as one of the modules of GAP training conducted by the DA-BPI, DA-ATI, and DA-RFO. Proof of completing the training may include a Certificate of Completion, photographs, and other documented records.


Republic of the Philippines
Cordillera Administrative Region
Department of Agriculture – RFO
BPI Compound, Guisad, Baguio City
and
Agricultural Training Institute
BSU Compound, La Trinidad, Benguet

award this

CERTIFICATE OF COMPLETION

to

JUAN DELA CRUZ

for having successfully completed the

Training on Good Agricultural Practices (GAP) for Vegetables and Fruits

On April 13-14, 2016
at Hotel Supreme, Magsaysay Avenue, Baguio City
Given this 14th day of April 2016

DR. LORENZO M. CARANGUIAN
OIC-Regional Executive Director

ARLENE L. FLORES, Ph.D
Center Chief

However, it is advisable to note that as mentioned in the explanatory note under 4.3.1, the DA-FPA implements and regularly updates its Guidelines in the Training and Accreditation of Agricultural Certified Pesticide Applicators (CPA) - Fumigator and Exterminator.

Image 25. **Sample certification of training in GAP**

4.6.4.3 First aid facilities (e.g., kits) should be readily available to treat workers of minor cuts and bruises and those that have been accidentally contaminated with chemicals prior to medical attention/treatment in a hospital.

Explanatory Note:

The size of the first aid kit typically adapts to the workforce scale on the farm. A first aid kit usually has a towel, clean clothing, an approved mask or mouthpiece for expired air resuscitation, a disposable eye wash bottle, eye wash solution, soap, nail brush, natural vinegar, baking soda (sodium bicarbonate), and povidone-iodine. Easy access to fresh water during first aid treatment is also important. Adequate first aid training of a minimum of two individuals is also preferable (ASEAN, 2006).

Image 26a. **First aid box and kits**

Image 26b. **First aid box and its contents**

4.6.4.4 First-aid and emergency instructions should be documented and conspicuously displayed in strategic locations.

Explanatory Note:

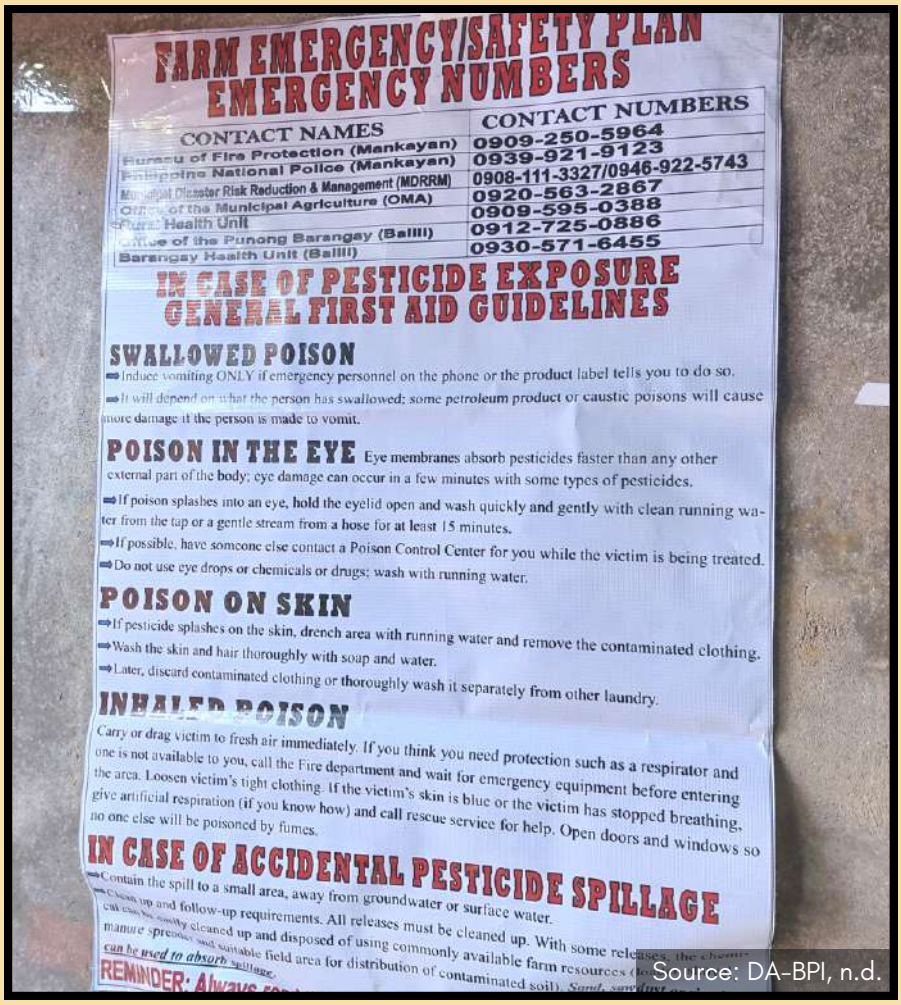


Image 27. **Contact Details and First Aid Guidelines in case of Emergency**

4.6.4.5 Authorized workers who are directly handling and applying chemicals should undergo pre-employment, periodic/annual and exit medical check-up to ensure their health and welfare.

4.6.5 Storage of Crop Protection Products

4.6.5.1 The crop protection product (covering both solid and liquid formulations) storage facility should comply with all the appropriate national or local regulations. It must have non-absorbent shelves such as metal or rigid plastic material to minimize the problem of contamination due to spillage.

Explanatory Note:

The Pesticide Regulatory Policies and Implementing Guidelines of DA-FPA provide the requirements for the storage of crop protection products. This may access it through https://fpa.da.gov.ph/

Chapter 5 Product Stewardship and Responsible Care, *sub-section 5.5 Transport, Storage and Disposal* provides the guidelines and regulations for the storage of pesticides recommended methods for coping with leakage and spill problems, as well as methods for disposing of unwanted pesticides and pesticide containers.

4.6.5.2 Chemicals should be stored in a well-lighted, well-ventilated, sound and secure structure, with access limited to the authorized personnel only. The structure should be located and constructed to minimize the risk of contaminating produce and should be equipped with emergency facilities in the event of a chemical spill, fire and other natural or man-made calamities.

Explanatory Note:

Proper storage of pesticides requires monitoring various factors that can cause the degradation of the stored products. These factors include physical aspects such as temperature and humidity, biological factors like molds and insects, chemical influences like acidity and corrosion, and mechanical issues like pressure packing. Even if the storage conditions are ideal, certain products can still deteriorate over time (FPA, 2020).

Good ventilation is crucial to prevent the accumulation of potentially hazardous vapors or fumes that chemicals may release, thus ensuring safe storage of the chemicals. It also helps in removing excess heat and moisture from the storage area. Proper airflow through the building helps maintain air quality and reduces the risk of personnel exposure to hazardous substances.

Vents allow sufficient airflow to maintain air quality, reduce the risk of exposure to hazardous substances, and allow any potentially hazardous fumes to safely exit the building before an explosion can occur (University of Massachusetts Amherst, n.d) .

When the pesticide storage is not in use, a lock keeps it secured and access limited to authorized personnel only. Warning signs posted on the door are another security measure that will prevent unauthorized individuals from accessing potentially dangerous chemicals.

A sample of a chemical storage area of a large farm is presented below.

Image 28. **A segregated crop protection products in the well-ventilated and secured storage area** *(Photo lifted from EM Code of GAP for Banana Production)*

The storage space must be clearly labeled as the "Pesticide Storage Area." Sunlight exposure can lead to chemical breakdown, so pesticides should not be stored in front of windows unless covered. Extreme temperatures can also cause chemical breakdown. To manage shelf life uncertainty, avoid storing pesticides for more than two years and consider marking the purchase date on the pesticide container (University of Massachusetts Amherst, n.d.).

Image 29. **Pesticide storage cabinet of a small farm with proper signage and lock for security**

For farms with limited resources or small quantities of pesticide, a small cabinet may be appropriate for storage, **as long as the risk of contamination and worker safety are considered**. For instance, one consideration is that inside the cabinet, there are non-absorbent shelves, such as metal or rigid plastic material or lining, to minimize the problem of contamination due to spillage.

4.6.5.3 Crop protection products should be stored in the original container with a legible label in accordance with the labelling requirements of the competent authority.

Explanatory Note:

Based on the DA-FPA Pesticide Regulatory Policies and Implementing Guidelines (2020 edition), the label provides readily-understood information on the following:

- content of the container and the purpose(s) for which it may be used;
- direction on how to use the pesticide;
- hazard of the pesticide and the appropriate precautions to take in its storage, handling, and use; and
- symptoms and signs of poisoning and the recommended first aid and medical treatment in the event of poisoning. Specific antidotes and appropriate dosages shall be contained in the labels.

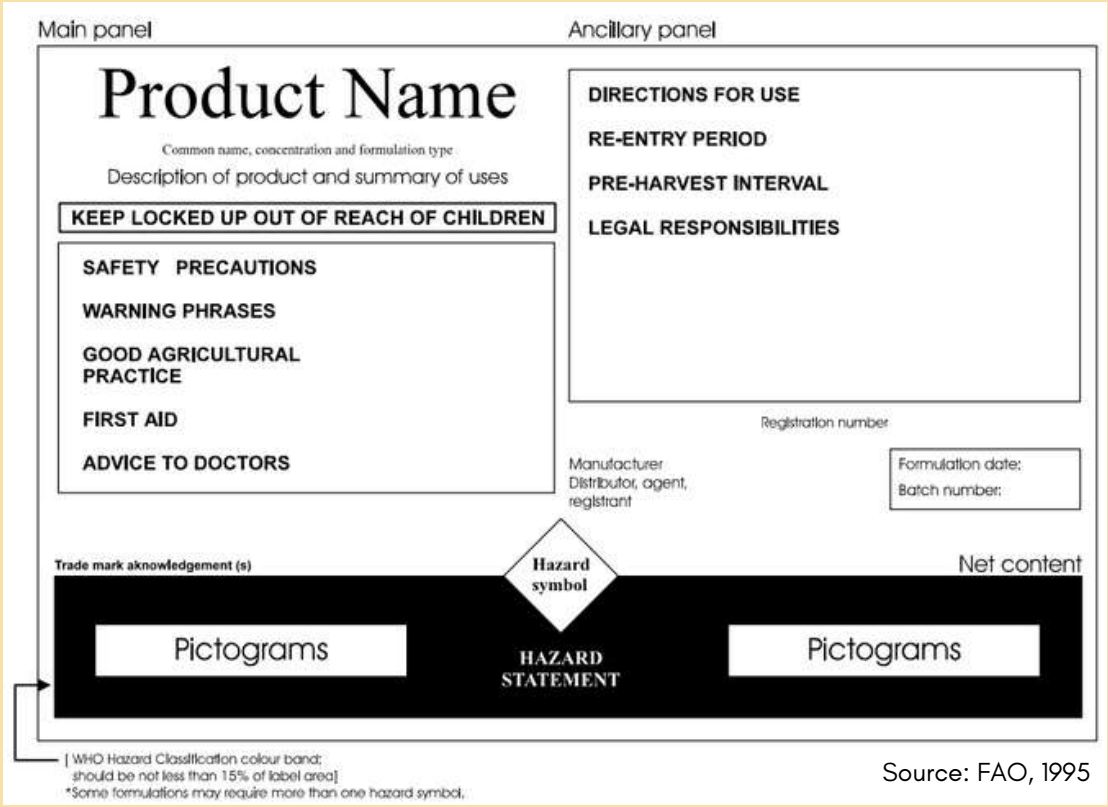


Image 30a. **Sample of a two panel label of pesticide**

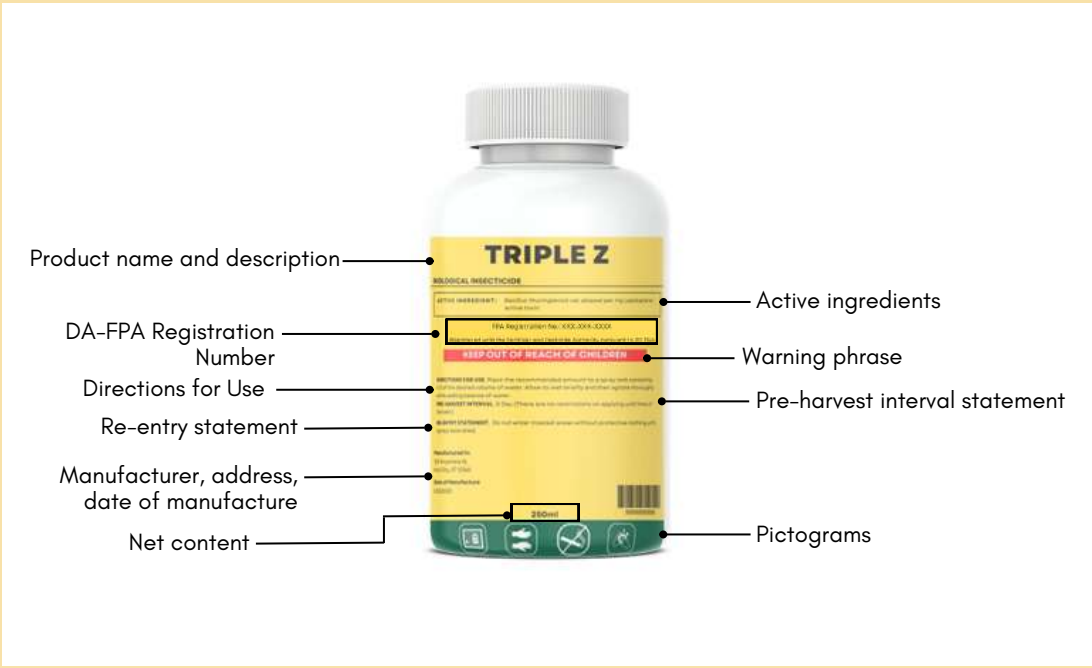


Image 30b. **An illustration of pesticide container with label information**

4.6.5.4 Proper segregation in the storage of crop protection products should be observed. Liquid formulations of chemicals must not be stored on shelves above powders.

Explanatory Note:

The image provided serves as an illustration of improper practice, as liquid chemical formulations should be placed on shelves below powdered substances.

Image 31a. **Sample of improper arrangement of chemicals**

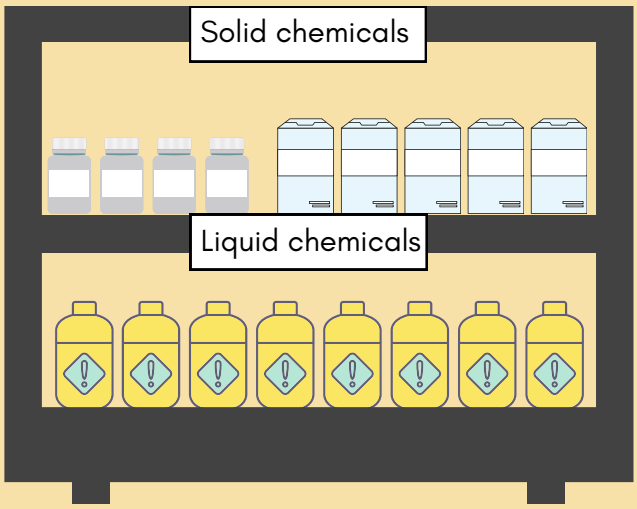


Image 31b. **Properly arranged chemicals placing the liquid formulations below the powdered ones**

Liquid agricultural chemicals can leak or spill, thus, contaminating the powders below them. Storing agro-chemicals this way, i.e., powder or solid ones on the top shelf, and liquid ones below, helps prevent contamination and minimizes the risk of accidents.

4.6.6 Maintenance and Storage of Equipment

4.6.6.1 Equipment used for chemical application should be maintained in good working condition. Such equipment should be checked by a technically competent person before each use.

4.6.6.2 Agricultural chemical sprayers should be calibrated as necessary, to maintain the precision of the application rate.

Explanatory Note:

Calibrating sprayers ensures that the intended volume of spray mixture is distributed to the target area (Michigan State University, 2002).

Here are the steps in the calibration of sprayer:

1. Determine a 2 x 50 m (100 m^2) area of land.
2. Fill sprayer tank with water.
3. Determine the time it takes to spray uniformly the measured area at a comfortable pace, constant speed and pressure.
4. Repeat Step 3 at least three times and calculate the average time needed to cover 100$m.^2$

5. Refill tank with water then dispense the spray into a container for the duration of the average time determined previously and get the volume of water.

6. Repeat Step 5 at least 3 times and calculate the average volume of water.

The illustration below provides a sample calculation of calibration of sprayer:

1. If 4 L were needed to spray $100 m^2$:

$$\text{To spray 1 } \cancel{ha} = 4 \text{ L} \times \frac{100\ m^2}{\cancel{ha}} = 400 \text{ L of spray solution needed}$$

2. Spray load per hectare:

For a knapsack sprayer with 10 L capacity,

$$= 400 \cancel{L} \times \frac{1 \text{ spray load}}{10 \cancel{L}}$$

4.6.6.3 Mixing containers, sprayers and other equipment and tools used for chemical applications should be thoroughly washed after use, especially when used with different agricultural chemicals on different crops, i.e., to avoid contamination of the produce or damaging the crop. Washings should be contained for proper disposal.

4.6.6.4 Protective clothing should be separately washed from other clothing and stored properly for future use.

Explanatory Note:

Separation of laundering of pesticide-soiled clothing with family wash minimizes the exposure of launderers to pesticides by doing the laundry and the transfer of pesticide residue to other clothing.

In the study of Rondl, R. and Schulze, L. (2000), the following were recommended to properly clean pesticide-soiled clothing:

- use of chemical-resistant gloves when doing the laundry;
- pre-rinsing to remove pesticide residue from the clothing;
- use pre-treatment products to help remove some pesticides from clothing;
- if feasible, use hot water;

- when using the washing machine, full level of water in the washing machine, and clean the washer a second time after washing contaminated clothes to prevent further transfer of any pesticide residue;
- wash contaminated garments a second time to ensure greater removal of pesticides; and
- hung the garments outside to dry (line drying) to get enough ventilation and sunlight to further remove pesticide residue if present.

4.6.7 Disposal of Crop Protection Products and Other Contaminated Wastes

4.6.7.1 Empty chemical containers should not be re-used and should be safely secured until these are disposed. Empty containers should never be used for food and drink related purposes.

4.6.7.2 Empty chemical containers are disposed of according to relevant country regulations and in a manner that minimizes the risk of contaminating produce. Official collection and disposal systems are used where available.

Explanatory Note:

The DA-FPA Pesticide Regulatory Policies and Implementing Guidelines states that the **disposal of empty pesticide containers shall be the shared responsibility** of the pesticide companies, their network of dealers/distributors, the users, local government units, and accredited waste generators/transporter and treatment/ storage/ disposal entities. The Guidelines also provide measures on how to manage empty pesticide containers. Below are a few details lifted from the DA-FPA Guidelines.

The general guidelines in empty container management are as follows:

1. **Rinsing**

   Strictly, all used pesticide containers shall be decontaminated before disposal. Cleaning must be undertaken immediately following the emptying of containers. It must be properly rinsed and the rinsate must be added to the spray tank as part of the make-up solution. The options that may be adopted are:

   a. Triple rinsing is applicable for smallholder farmers who do not have mechanical rinsing equipment. It follows the following stages: a) Empty the container of its contents into the mixing tank and drain for 30 seconds; b) Rinse the container at least three times with a volume of water not less than 10% of the container's total volume; and c) add the rinsate each time to the mixing tank.

b. Pressure rinsing is applicable for farmers and/or plantation-type operations that have mechanical equipment. The jets of water hit the internal surfaces of the container removing and dissolving the residues.

Whichever method of rinsing is used, the rinsate should be added directly to the spray solution and not be thrown elsewhere.

2. **Burying or burning of empty containers or packaging is prohibited.**

3. **Collection of empty containers**

   a. The pesticide dealers are hereby designated as primary collection points of properly rinsed packaging. They are, therefore, mandated to provide properly sealed drums in a secured area in their premises as temporary holding areas where their clients should bring their rinsed containers. The dealers shall maintain a record of the rinsed containers they receive, from the company. A report on such should be submitted to the nearest DA-FPA office every quarter.

   b. Thereafter, the pesticide dealers shall bring the collected rinsed pesticide containers to the DENR-EMB-accredited waste generator near their area. The waste generator which may be the Local Government Units, NGO's or the private sector, must be compliant with the provisions of Republic Act 6969 or The Toxic Substances and Hazardous and Nuclear Waste Control Act and Its Implementing Rules and Regulations. They are required to assign a Pollution Control Officer for this purpose.

   c. Plantation owners are hereby mandated to collect their empty containers. They shall keep a record of empty containers by the company and shall submit such to the nearest DA-FPA office quarterly. They must seek accreditation with DENR-EMB as waste generators and are required to assign a Pollution Control Officer.

Full information on the Guidelines is available on the DA-FPA website. The DA-FPA Guidelines may be updated from time to time to introduce new provisions on the disposal of pesticide containers and DA-FPA acceptance of third-party authorizations (TPA).

4.6.7.3 Crop protection product containers should be rinsed three (3) times prior to disposal and should be disposed according to label directions.

4.6.7.4 Expired or banned chemical should never be used for crop protection purposes. Obsolete chemicals are disposed of through official collection systems or in legal off-site areas.

4.6.7.5 Tank washings should be disposed appropriately to avoid contamination of the produce and minimize the risk of environmental harm within and outside the site.

4.6.7.6 All pesticide-contaminated wastes shall be disposed in a designated sanitary landfill, if available.

Explanatory Note:

Sanitary landfill is a method of waste disposal on land without disrupting the environment and public health (JeyaSundar, et.al., 2020). In case of nonavailability of sanitary landfill, knowledge of the official waste collection system is also useful which is discussed in the explanatory note under Section 4.6.7.2.

4.6.7.7 Fuels, oils and other unusable non-agrichemicals should be disposed properly to avoid the risk of contaminating the produce.

4.6.8 Environmental Safety

4.6.8.1 To prevent possible ecological imbalance, growers should use biological controls that are authorized for the cultivation of specific fruit or vegetable and should be used in accordance with the approved instructions for the intended purpose/s.

Explanatory Note:

Biological control is known as environmentally friendly pest management that uses one kind of organism (the natural enemies) to control another (the pest species) (Sonmez & Mamay, 2018, Baker, et al., 2020). Biological control can be naturally occurring; foreign agents classically introduced and established; released native or foreign agents augmenting populations; or conserved or enhanced populations of native or foreign agents (Baker, et al., 2020).

According to ASEAN (2014), biocontrol agents (BCA) are classified into four categories, namely:

- microbial control agents (MCA or microbials);
- macro-organisms (macrobials);
- semiochemicals (mostly pheromones, kairomones, etc); and
- natural products (plant extracts or "botanicals", fermentation, and other products.

The websites of DA-FPA and DA-BAFS are sources of information on registered biocontrol agents, and OBCA, respectively.

4.6.8.2 Farm activities comply with country regulations covering protected plant and animal species to ensure that protected species are not damaged.

4.6.8.3 To conserve native plant and animal species, access and activity is managed in significant remnant native vegetation areas, wildlife corridors, and vegetation areas on and near the banks of waterways.

4.6.8.4 Measures are used to control feral animals and environmental pests.

Explanatory Note:

Most feral animals fall into one of three categories: exotic animals introduced accidentally, domestic animals turned wild, or exotic species intentionally released into the wild for pest control or recreational purposes. The environmental impacts of feral animals are diverse, including predation on native species, competition for food and habitat, habitat degradation, soil erosion, disease transmission, and weed dissemination.

Complete eradication of feral animals is not feasible. While biological control is slowly being introduced, current management efforts focus on reducing localized populations where feral animals significantly impact biodiversity or farm productivity. Various methods and techniques are available for feral animal control.

Physical barriers such as screens, fences, or walls are commonly used. Some employ noise-making and reflectorized materials, while others use scarecrows. The choice of control method depends on the target species and the environmental context. It's crucial to consider the potential impact on non-target native species when implementing control techniques (Langley, 2023).

Image 32. **Use of barbed wire as fence surrounding the farm**

4.6.8.5 The generation of offensive odor, smoke, dust, and noise is managed to minimize the impact on neighboring properties.

Explanatory Note:

Odor, smoke, dust, and noise can be minimized by the following control measure.

Table 3. **Sample control measure related to managing the environment**

Hazard	Control Measure
Odor	Use of probiotics [(e.g. Lactic Acid Bacteria Serum (LABS)]
Smoke	Avoid burning
Dust	Use of cover crops and physical barriers
Noise	Proper maintenance and time of operation of machineries

4.7 Harvesting and Handling Produce from Harvest to Storage prior to Transport

4.7.1 Harvesting

4.7.1.1 Practices that are critical to managing produce safety and quality during production, harvesting and postharvest handling are identified for the crop grown.

4.7.1.2 Appropriate maturity indices should be the bases in determining the harvest time.

Explanatory Note:

The timing of fruit and vegetable harvesting is essential for their storage, quality, and marketability. The lifespan of fruits and vegetables can be distinguished based on maturation, ripening, and senescence.

Maturation signifies that the fruit is ready for harvest when its size is fully developed, although it may not be ready for immediate consumption.

Ripening typically occurs after maturation, making the produce edible and flavorful.

Senescence is the final phase marked by natural deterioration, resulting in texture and flavor loss until the fruit tissue dies

Maturity indices may be observed based on the following:

- Skin color;
- Shape;
- Size;
- Aroma;
- Fruit opening;
- Leaf changes;
- Abscission; and
- Firmness (FAO, 2003).

Generally, it is advisable to harvest when the following have been achieved: good quality; desired size; and long term storability (DOST-PCAARRD, 2020).

Examples from UPLB-PHTRC are presented in Annex A.

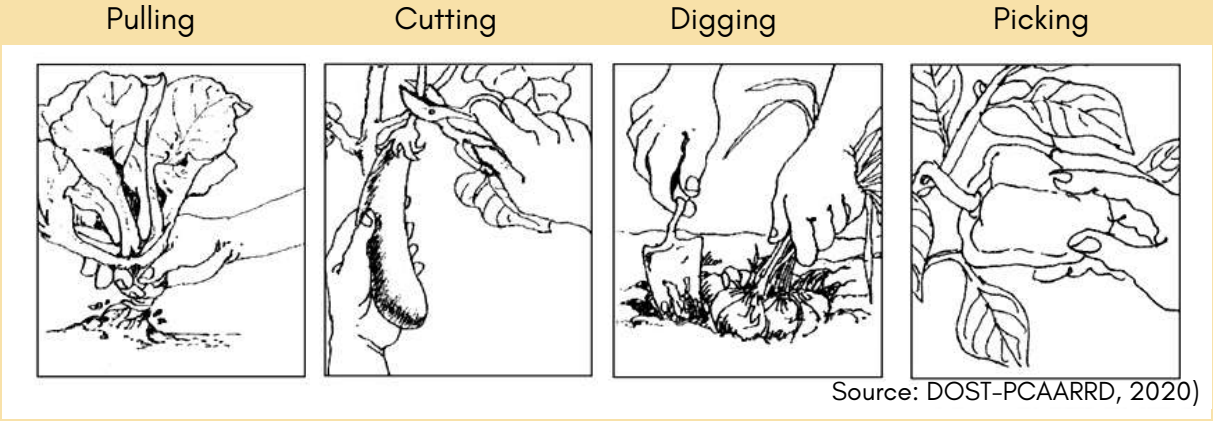
4.7.1.3 Appropriate harvesting technique should be employed in harvesting to optimize the quality and other desired characteristics of produce during harvest or postharvest phases.

Explanatory Note:

Harvesting can be done by hand, using tools or machines during harvesting depending on the type of fruit or vegetable (FAO, 1989). Harvesting tools include knives, scissors, ladders, nets, and rigid harvest containers. However, choosing the appropriate tools for harvest is crucial to minimize waste, minimize mechanical injury, sustain the quality of harvested produce, and improve efficiency. Selecting the right tool for each crop, such as handheld pruners for delicate herbs, or sharp garden knives for crops with thicker stems or roots, helps minimize plant damage and ensures a smooth and efficient harvest (Tools, n.d.).

Image 33a. **Use of pruning shear in harvesting eggplant**

Other harvesting methods is illustrated below (DOST-PCAARRD, 2020).



Source: DOST-PCAARRD, 2020)

Image 33b. **Different harvesting methods depending on the type of crop**

- **Pulling** is preferably for harvesting mustard, pechay, celery, carrot, and radish (convenient if the soil is sandy).
- **Cutting** is preferably for cabbage, broccoli, cauliflower, and eggplant.
- **Digging** is preferably for sweet potato, taro, white potato, onion, and radish.

The illustrations provided are not exhaustive, and there may be other harvesting techniques, especially with technological advancements. The key focus is to use methods ensuring food safety, minimizing mechanical injury, preserving produce quality, and enhancing efficiency.

4.7.1.4 Harvesting time should be done in accordance to commodity requirements. Harvesting under the rain should be avoided. Fresh fruits and vegetables that are unfit for human consumption should be segregated during harvesting. Those which cannot be made safe by further processing should be disposed properly to avoid contamination of the uncontaminated produce.

Explanatory Note:

Harvesting many vegetables, including baby corn and sweet corn, as well as fruits, is most effective during the early morning or the coolest part of the day. The lower temperatures in the morning help prevent moisture loss, contributing to the crispness and freshness of the harvested produce. Additionally, the natural sugars accumulated in plants overnight enhance the sweetness and flavor. Morning harvesting is gentler on plants, reducing stress and the risk of wilting and nutrient loss.

Furthermore, fruits and vegetables with latex, such as mango and papaya, and leafy vegetables like pechay, lettuce, and cabbage, are susceptible to stem and leaf breakage due to turgidity. Care should be taken during harvesting to avoid damage to these crops (Backyard Boos, n.d.).

4.7.1.5 Containers used for harvesting should be suitable and clean before use. Liners are preferably used to protect the produce, particularly when containers have rough surfaces.

Explanatory Note:

Harvesting containers that are easy to handle can help workers pick fruits and vegetables in the field. The choice between the use of rigid and non-rigid containers may be influenced by the following factors: the need for gentle handling, flexibility, length of storage, and costs.

Many crops are harvested into bags. Harvesting bags with shoulder or waist slings can be used for fruits with firm skins, like citrus fruits and avocados. These bags often come equipped with shoulder or waist slings and are crafted from materials such as paper, polyethylene film, sisal, hessian, or woven polyethylene and are relatively cheap but give little protection to the crop against handling and transport damage. Sacks, on the other hand, are commonly used for crops such as potatoes, onions, cassava, and pumpkins (Barbosa-Cánovas et al., 2003).

Image 34a. **Use of rigid container in harvesting**

Other types of field harvest containers include baskets, buckets, carts, and plastic crates. For high-risk products, woven baskets and sacks are not recommended because of the risk of contamination.

Image 34b. **Use of crates for harvesting okra**

4.7.1.6 If the containers are recycled, these should be properly cleaned or discarded accordingly if found unfit for use.

4.7.1.7 Harvested produce should not be placed in direct contact with the soil or floor in the handling, packing or storage areas.

Explanatory Note:

After harvesting, it is important to avoid direct contact between the produce, especially the cut surfaces, and the ground or the floors in handling, packing, and storage spaces. Soil and dirty floors can introduce biological contaminants. The cut surfaces of the produce can serve as points of entry and nutrients for pathogenic microorganisms. To prevent contact with dirt and other substances, materials like paper, plastic, or timber can be placed on the ground or floor (ASEAN, 2006).

Image 35a. **Harvested eggplants placed in clean crate and in an elevated container**

Image 35b. **Harvested onions in red sacks placed on the floor with lining to prevent contact with the soil**

4.7.2 Packaging

4.7.2.1 Produce should be graded and packed according to market requirements.

Explanatory Note:

For reference, some of the infographics of PNS of fruits and vegetables with grading and classification are found in Annex B. These can also be downloaded from the BAFS website at www.bafs.da.gov.ph under the "Publications" tab.

Image 36a. **Webpage of DA-BAFS for published infographics of various PNS**

Image 36b. **Sample classification of vegetables based on market requirements**

Image 36c. **Sample of retail packaging according to classification**

4.7.2.2 When packing of fresh fruits and vegetables is done in the field, contaminated containers or bins exposed to the sources of contaminants (i.e., manure) should be avoided.

4.7.2.3 Protective materials should be used whenever appropriate to protect the produce from rough surfaces of containers and exposure to sunlight leading to excessive moisture loss.

Explanatory Note:

The packaging materials should be appropriate to contain the produce in convenient units for handling and distribution, protect to minimize damage during transport and storage, extend the shelf-life of the produce, and identify and provide useful information about the produce.

In addition to the requirements mentioned in this PNS, another reference that can be checked for the packaging and transport of fresh fruits and vegetables to maintain produce quality is the PNS Code of Practice (COP) for Packaging and Transport of Fresh Fruits and Vegetables (PNS/BAFS 198:2017).

Below are some of the provisions of the PNS/BAFS 198:2017 that can serve as a reference in packaging fruits and vegetables.

Image 37. **Cover page of PNS/BAFS 198:2017**

Section 5 Packaging to Maintain Produce Quality During Transportation and Marketing

5.1 Packaging must withstand:

a) rough handling during loading and unloading;
b) compression from the overhead weight of other containers;
c) impact and vibration during transportation; and
d) high humidity during precooling, transit, and storage.

5.2 Packaging materials are chosen on the basis of needs of the produce, packing method, precooling method, strength, cost, availability, buyer specifications, and freight rates. Importers, buyers, and packaging manufacturers provide valuable recommendations. Materials used include:

a) paperboard or fiberboard bins, boxes (glued, stapled, interlocking), lugs, trays, flats, dividers or partitions, and slip sheets;
b) wood bins, crates (wire bound, nailed), baskets, trays, lugs, pallets;
c) paper bags, sleeves, wraps, liners, pads, excelsior, and labels;
d) plastic bins, boxes, trays, bags (mesh, solid), containers, sleeves, film wraps, liners, dividers, and slip sheets; and
e) foam boxes, trays, lugs, sleeves, liners, dividers, and pads.

5.3 Bins, boxes, crates, trays, lugs, baskets, and bags are considered shipping containers. Baskets, however, are difficult to handle in mixed loads of rectangular boxes. Bags provide limited produce protection. The fiberboard type box is a widely used container.

For full information, the PNS can be downloaded on the BAFS website at www.bafs.da.gov.ph.

One of the packaging techniques used to extend the shelf-life and maintain the freshness of fresh fruits and vegetables is Modified Atmosphere Packaging (MAP) using polyethylene plastic bags. Based on the study of UPLB-PHTRC (n.d.), below are the recommended MAPs for select fruits and vegetables.

Table 4. **Sample of recommended MAP for different fruits and vegetables**

Produce	Recommended MAP
Calamansi	4 pinholes/kg; 160 pinholes/20 kg
Banana (any variety)	no pinhole nor punch hole
Papaya	2 pinholes/kg
Broccoli	1 pinhole/4 heads
Tomato	4 pinholes/kg; 160 pinholes/20 kg
Rambutan	8 pinholes/kg
Lanzones	16 punch holes/kg
Saluyot	2 pinholes/kg
Saluyot	2 pinholes/kg
Malunggay	2 pinholes/kg
Pechay	2 pinholes/kg
Cassava (fresh)	8 pinholes/2 kg; 80 pinholes/10 kg

Image 38a. **Use of polyethylene plastic bags as packaging**

Image 38b. **Use of corrugated box as packaging material for dragon fruit**

4.7.3.4 If the harvested and packed produce stored on farm, storage areas must be clean and, if applicable, temperature and humidity controls are maintained.

4.7.3.5 Produce that are packed and handled directly in the field, orchard or greenhouses must be removed from the field and transported to the processing area as quickly as possible in order to prevent post-harvest losses and contamination.

4.7.3 Pre-Transport

4.7.3.1 Harvested produce should be placed under shade or any covered area if transport is delayed.

4.7.3.2 Any ice used for pre-cooling the produce and used at point of harvest must be made with potable water and handled under sanitary conditions to prevent produce contamination.

Explanatory Note:

Precooling is essential for maintaining an optimal postharvest life and minimizing the impact of senescence on the market quality of fruits and vegetables. It is also considered one of the most economical methods to help preserve the quality and prolong the shelf life of commercial crops. Precooling can be achieved by several techniques such as room cooling, hydrocooling, vacuum cooling, forced air cooling, and contact icing.

Pre-cooling through top icing is done by placing crushed ice on top of the produce or to produce packed in boxes to cool down the produce and extend shelf-life. Note, however, that the produce should not have direct contact with the ice. Top icing is usually done for asparagus, broccoli, leaks, green onions, radishes, and sweet corn (Dumont, Orsat, & Raghavan, 2016).

Image 39. **Strawberries placed in a styrofoam box topped with ice**

4.7.3.3 After grading and classification, the produce should be packed in suitable containers. To minimize mechanical damage, packed containers should not be stacked on top of each other unless the containers are designed for stacking.

Explanatory Note:

Image 40. **Use of rigid containers for packaging produce**

4.8 Transport

4.8.1 All field-packed produce must be covered during transport in order to prevent contamination.

4.8.2 Refrigerated transport vehicles should be installed with temperature settings that will minimize quality loss of the produce.

4.8.3 Containers filled with produce are not placed in direct contact with soil where there is a significant risk of contaminating produce from soil on the bottom of containers.

Explanatory Note:

Contamination of produce with pathogenic microorganisms may occur if soil from the bottom of a container falls onto produce in a container stacked underneath it. The risk of such contamination causing a food safety outbreak is highest for produce that is consumed raw.

When stacking containers, it is essential to inspect the base of the containers for the presence of soil and other foreign matter. If necessary, the base is cleaned before stacking, or avoid placing the container on top of others (ASEAN, 2006).

4.8.4 Pallets and transport vehicles should be checked before use for cleanliness, chemical spills, foreign objects and pest infestation. Pallets should be thoroughly cleaned and covered with protective material or rejected if there is a significant risk of contaminating produce. Transport vehicles should be cleaned if there is a significant risk of mechanical damage and contaminating produce.

Explanatory Note:

Pallets and transport vehicles have the potential to introduce contamination, from previous chemical and fertilizer spills, pest infestation, and the accumulation of dirt and foreign debris.

The inspection of pallets and transport vehicles may cover cleanliness, the presence of chemical residues, foreign objects, and signs of pest infestation. When contamination risks are observed, appropriate measures such as cleaning, applying protective coverings, or rejecting the item are taken (ASEAN, 2006).

Image 40. **Clean vehicle for transport of fruits and vegetables**

4.8.5 Produce should be transported separately from goods that are potential sources of chemical contamination and causes of biological and physical hazards. Moreover, mixing of non-compatible produce during transport should be avoided.

Explanatory Note:

In practice, dedicated transport vehicles exclusively to transport and store fresh produce are not always feasible. As such, the transport of fresh produce is 'mixed loads'. During mixed loads transport, it is essential to combine only those commodities that are compatible with their requirements for temperature, modified atmosphere, relative humidity, and protection from odors or physiologically active gases, such as ethylene.

Ethylene causes premature ripening and destruction of other produce. Thus, it is recommended to avoid mixing ethylene producer commodities with those sensitive to it during transport.

The table below provides information on ethylene-sensitive produce and those that are ethylene producers.

Table 5. **Produce that are ethylene sensitive and ethylene producers**

Ethylene-sensitive produce	
Banana (unripe)	Carrot
Broccoli	Eggplant
Cauliflower	Green beans
Cabbage	Watermelon
Cucumber	Parsley
Leafy greens	Pepper
Okra	Squash
Lettuce	Sweet potato
Peas	Yam

Ethylene producers	
Banana (ripe)	Papaya
Avocado	Rambutan
Melon	Tomato
Mangosteen	Guava
Mango	Passionfruit

Source: McGregor, 1987

The table below lists down produce that are odor-producing and those that are odor-absorber:

Table 6. **Produce that are odor-producing and odor-absorber**

Odor producer	Odor absorber
Avocado	Pineapple
Carrot	Celery
Ginger root	Eggplant
Green onion	Corn, grapes
Potato	Apple
Green pepper	Pineapple
Strongly scented vegetables	Citrus fruit

Source: McGregor, 1987

4.8.6 For long delays before transport, produce should be kept at the lowest possible temperature condition.

Explanatory Note:

Maintaining product quality between harvest and consumption is highly dependent on temperature control. Fruits, vegetables, and cut flowers are living tissues separated from their parent plant, and temperature plays a crucial role in preserving their quality.

Keeping products at their lowest safe temperature (0°C or 32°F for temperate crops, or 10-12°C or 50-54°F for chilling-sensitive crops) is essential. This can increase storage life, lower respiration rate, reduce sensitivity to ethylene gas, and decrease water loss.

Cooling involves heat transfer processes such as conduction, convection, radiation, and evaporation. Mechanical refrigeration systems, including room cooling, forced-air cooling, and evaporative cooling, are reliable for maintaining low temperatures. Practices like providing shade over harvested produce, packing areas, and transport vehicles can enhance storage system efficiency (FAO, 2004).

Moreover, relative humidity in the storage environment is crucial for preventing water loss and maintaining quality. Mechanical refrigeration with larger refrigerator coils helps maintain higher relative humidity in cold rooms (FAO, 2004).

Section 4.9.3 Cooling System of Fruits and Vegetables of this Explanatory manual discusses more of the requirements for lowering the temperature of fruits and vegetables.

In addition to the explanations above, storage and transport of produce should be compatible in terms of temperature and relative humidity (RH). Below are the temperature and relative humidity recommended for some fruits and vegetables to maintain its quality.

Table 7. **Temperature and relative humidity recommended for select fruits and vegetables**

Group 1: 0-2 °C	
90-95% RH	**95-100% RH**
Grapes (without sulfur dioxide) Longan Lychee Leeks Radish	Asparagus Broccoli Cabbage Carrot Leeks Cauliflower Sweet corn Lettuce Sweet peas

Group 2: 10 °C, 85-90% RH		
Beans Pepper Eggplant	Pummelo Cucumber Okra	Calamondin Tamarind Potato

Group 3: 13-15 °C , 85-90% RH				
Avocado Guyabano Mango Papaya	Squash Mangosteen Guava Ampalaya	Rambutan Passionfruit Atis Jackfruit	Ginger Tomato Santol Durian	Banana Pineapple

Source: McGregor, 1987

4.8.7 When farm vehicle used for transporting harvested produce are also used for other purposes, it should be cleaned prior to hauling to avoid contamination of the produce.

Explanatory Note:

Cleaning of multi-purpose farm vehicles before hauling harvested produce is essential for maintaining food safety and quality. Cleaning is different from sanitizing. Cleaning refers to the physical removal of dirt and organic matter from surfaces, using water and a detergent. Sanitizing is the treatment of a cleaned surface to reduce or eliminate microorganisms (University of Massachusetts Amherst, n.d.).

Cleaning and sanitizing is a four-step process, which includes:

1. removing any obvious dirt or debris from the surface or bed of the farm vehicle;
2. applying detergent and scrubbing. Detergents should be appropriate for use on food contact surfaces.
3. rinsing the surface or bed with clean water to remove soil and detergent; and
4. applying sanitizer approved for use on food contact surfaces. Rinse if required by label (South Dakota State University Extension, n.d.).

Image 41. **Clean vehicle for transport of fruits and vegetables**

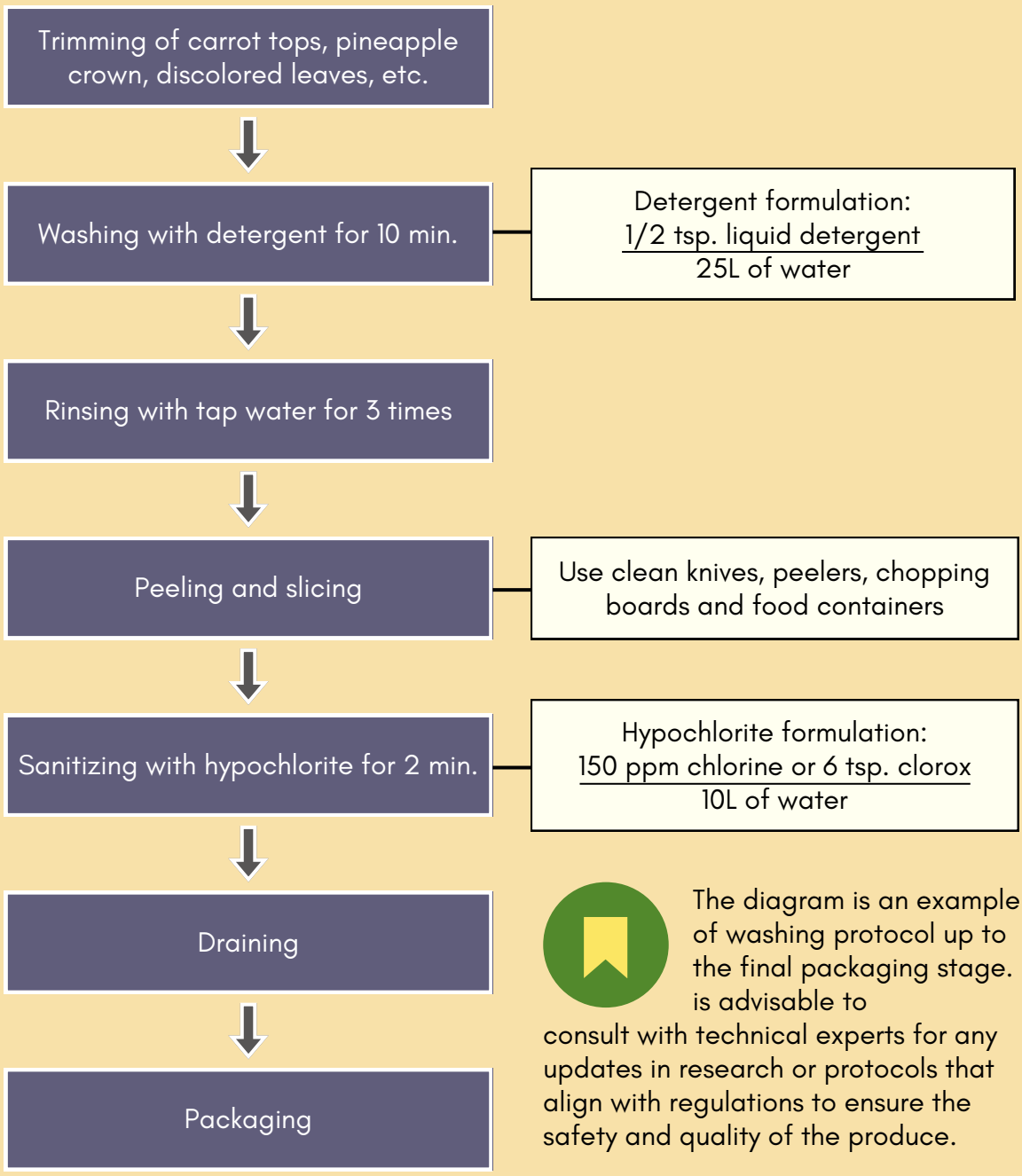
4.9 Specific Process Steps

4.9.1 Post-Harvest Washing

4.9.1.1 Whenever required, the produce should be treated with approved washing protocols to minimize disease development and loss of quality.

Explanatory Note:

Washing fruits and vegetables reduces microbial contamination by 90%. Here is an example of a standard washing protocol.



The diagram is an example of washing protocol up to the final packaging stage. It is advisable to consult with technical experts for any updates in research or protocols that align with regulations to ensure the safety and quality of the produce.

4.9.1.2 Water used for washing the produce should be analyzed at least annually. The levels of water quality parameters should be maintained within accepted WHO thresholds or are accepted as safe for the food industry by the competent authority.

Explanatory Note:

The risk of biological contamination increases when water comes into contact with the edible parts of produce, either just before harvesting or during post-harvest handling and packing (ASEAN, 2006). In essence, water analysis can help assess the levels of various water quality parameters to ensure its safe usage. This will also help identify any corrective action, if necessary.

4.9.1.3 The water to be used for final washing of the edible parts of produce should have quality equivalent to potable water standard, although clean water can be used for the initial washings.

4.9.1.4 Where appropriate, the temperature of the post-harvest water should be controlled and monitored. The temperature monitoring record is kept for traceability.

4.9.1.5 Ice to be used for cooling purposes should be made from potable water. The production, handling and storage of ice for postharvest purposes should follow appropriate safeguards to avoid contamination.

4.9.1.6 In the case that water is re-circulated or recycled for final washing of the produce, proper filtering and disinfection process should be done. The pH and microbial load should be routinely monitored. A routine cleaning schedule according to the usage should be maintained and documented.

4.9.1.7 Post-harvest systems that use water for washing the produce should be designed in a manner that minimizes product lodges and dirt build up.

4.9.2 Postharvest Treatment

4.9.2.1 Anti-microbial agents should only be used when absolutely necessary to minimize cross-contamination during postharvest and when used for good hygienic practices. The level of anti-microbial agents should be monitored and controlled. Washing of fruits and vegetables should be done to ensure that chemical residues do not exceed levels as recommended by the Codex Alimentarius Commission.

Explanatory Note:

While antimicrobials can reduce pathogen populations on the surface of fresh produce, they are generally less effective on leafy vegetables compared to non-leafy vegetables (Gombas et al., 2017).

Antimicrobials are most effective in preventing the transfer of microbial pathogens via wash water to noncontaminated produce, preventing cross-contamination through water.

In selecting antimicrobial chemicals it is important to consider their effectiveness, regulatory approval, compliance with standards, stability, quality and sensory effects, worker safety, corrosion effects on equipment, wastewater treatment, and environmental impact. The commonly used antimicrobial agents in fresh-cut produce are chlorine, peracetic acid, chlorine dioxide, and ozone are often used in fresh-cut produce washing processes (Gombas et al., 2017).

4.9.2.2 The farm should only use materials for postharvest treatments such as waxes, to include fungicides, and other chemicals that are approved and registered by competent authority. Postharvest treatment materials should be carried out in accordance with label instructions.

4.9.2.3 Sprayers for postharvest treatments should be calibrated regularly to control the accuracy of the application rate. After use, sprayers should be thoroughly washed in safe areas, particularly when different chemicals are used to avoid contamination of the produce.

4.9.3 Cooling System of Fresh Fruits and Vegetables

4.9.3.1 When pre-cooling is required, it should be done in accordance to the requirements of specific fresh fruit(s) or vegetable(s). When appropriate, fresh fruits and vegetables should be maintained at low temperatures after pre-cooling to minimize microbial growth. The temperature of the cold storage should be controlled and monitored.

Explanatory Note:

The explanatory note of Section 4.8.6 discusses the recommended temperature of fruits and vegetables during storage and transport.

4.9.3.2 Condensate and defrost water from evaporator type cooling systems (e.g., vacuum cooling, cold rooms) should not drip onto fresh fruits and vegetables. The inner side of the cooling systems should always be clean.

Explanatory Note:

When condensates and defrost water from cooling systems come into contact with fresh produce, the risk of contamination increases since this water may carry microorganisms or impurities that can affect the safety and quality of the fruits and

vegetables. Furthermore, excess water on the surface of fruits and vegetables can lead to mold and bacterial growth, thus, accelerating its deterioration.

Preventing moisture exposure helps maintain the visual appeal and shelf life of the produce. To prevent condensation and defrost water from affecting fresh produce, proper design and maintenance of the cooling system, and sanitation procedures help ensure that such water is diverted away from the produce and the risk of condensate and defrost water from coming into contact with the fresh produce properly managed (Linke & Geyer, 2013).

4.9.3.3 Potable water should be used in cooling systems, particularly when water or ice is in direct contact with fresh fruits and vegetables (e.g., hydro-cooling, ice-cooling). The water quality in these systems should be controlled and maintained.

4.9.3.4 Forced-air cooling involves the use of rapid movement of refrigerated air over fresh fruits and vegetables in cold rooms. Air-cooling systems should be appropriately designed and maintained to preserve quality and to avoid contaminating the fresh produce.

4.10 Off-Farm Facility for Produce Handling and/or Storage

4.10.1 Floors should be designed with appropriate slopes, drainage channels and kept free and clear to ensure good drainage system.

Explanatory Note:

Floors designed with appropriate drainage will help in ensuring safe and sanitary operations.

Image 42. **Clean drainage channel for an effective drainage system**

4.10.2 Produce handling facilities and equipment such as process lines and machinery, floors, storage areas, pallets as well as floors and walls should be cleaned and/or maintained regularly to prevent contamination.

4.10.3 Rejected produce and waste material should be disposed properly in designated areas to prevent contamination of the produce.

4.10.4 Cleaning agents, lubricants, etc. should be kept in a designated area that is separate and apart from packing area to avoid chemical contamination of produce.

4.10.5 Domestic animals should not be allowed to enter processing facilities to prevent contamination of the produce.

Explanatory Note:

The processing facilities, including the packinghouse, are enclosed to avoid the entry of domestic animals. Allowing domestic animals to enter processing facilities can lead to contamination of the produce, posing significant risks to food safety. When animals enter the processing area, they may carry pathogenic microorganisms that can transfer to the equipment, surfaces, or the food itself.

Common materials used to enclose a packinghouse are fences made from wire mesh or other durable materials, concrete walls, and nets or mesh screens.

Image 43. **Enclosed packinghouse to avoid entry of domestic animals**

4.10.6 There must be monitoring and management systems for pest control to avoid or minimize pest infestation. Traps and baits should be identified in the building lay out map.

4.11 Personal Hygiene and Farm Sanitation

4.11.1 Personal Hygiene

4.11.1.1 Workers should have appropriate knowledge or must be trained in personal hygiene practices.

Explanatory Note:

Workers need to understand how they could potentially spread contamination and follow proper personal hygiene practices (ASEAN, 2006).

Basic personal hygiene practices include:

- using of correct methods for washing and drying hands after visiting the toilet, handling animals, smoking, eating, and handling waste food and trash;
- covering cuts and sores, and
- informing the supervisor if sick (ASEAN, 2006).

4.11.1.2 Farm workers should comply with farm hygiene regulations such as observance of personal cleanliness and appropriate clothing (i.e., hand washing, wearing of jewelry and fingernail length and cleaning, etc.) and personal behavior (i.e., no smoking, spiting, eating, chewing, etc.).

Explanatory Note:

Sample signages that can help remind workers of personal cleanliness are shown below.

Image 44a. **Sample signages to help ensure the cleanliness within the farm**

Image 44b. **Sample reminders to workers to avoid contaminating the produce**

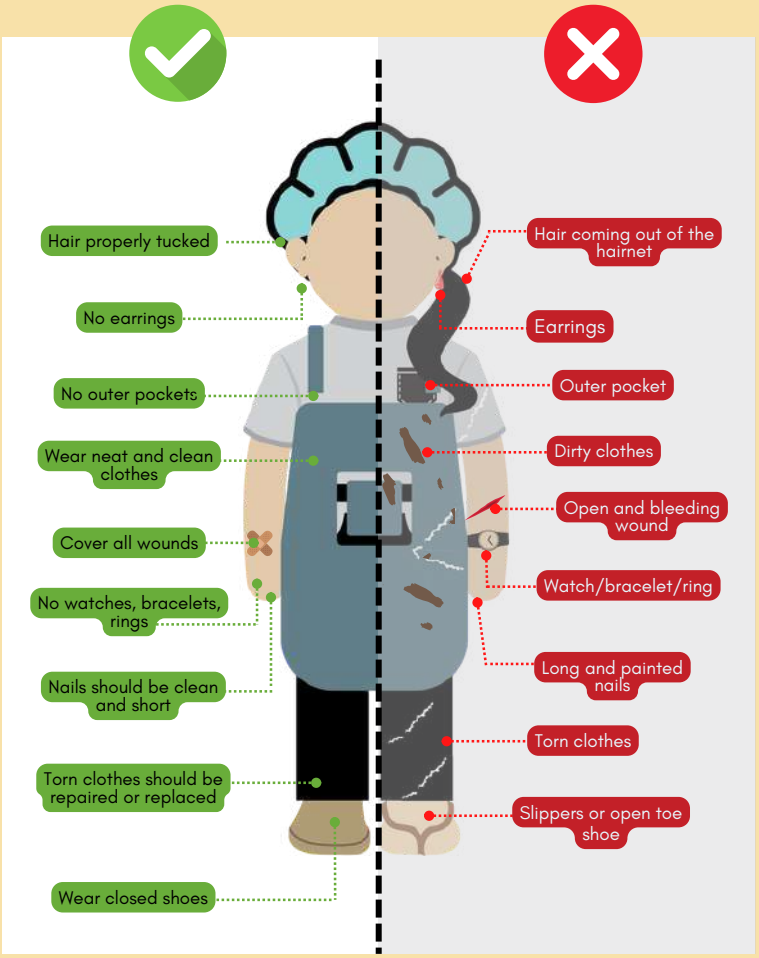


Image 44c. **Illustration on the dos and don'ts related to personal hygiene**

Images below show the appropriate working clothes based on the farm activity.

Image 44d. **Sample of proper working clothes in the farm**

Image 44e. **Sample of proper working clothes in the packinghouse**

4.11.1.3 Written instructions on personal hygiene practices should be provided to workers or displayed on prominent locations.

Explanatory Note:

Personal hygiene instructions are preferably presented in a language that workers can easily understand and in a straightforward manner. Photographs, diagrams, and other visual aids can help communicate messages effectively (ASEAN, 2006).

Image 45a. **Written instruction on handwashing posted in the handwashing facility**

Image 45b. **Written instructions on handwashing posted in the handwashing facility**

4.11.1.4 Fixed or mobile toilets and hand washing facilities should be available and accessible to the workers and should be properly maintained in good hygienic condition. These should be located in an appropriate area.

Explanatory Note:

The availability of accessible hand-washing facilities and toilets is important for disease prevention, hygiene and sanitation, workplace hygiene, and workers' health and productivity.

The following are important considerations for toilets and hand washing facilities in the production area or processing area.

1. Accessibility means that the facilities are near the workers' work areas and are available at all times. Accessible facilities help lower the chance that workers will relieve themselves in undesignated areas, such as in fields, and thereby risk contamination of produce.
2. The location of toilet facilities takes into account the potential runoff during heavy rain and its distance from the sources of irrigation water. Meanwhile, the construction examines the possible contamination of fields, soil, and animals.
3. Toilet and hand washing facilities have a sufficient supply of water, soap, single-use towels, or toilet paper, and a waste container. The wash water is also captured or collected for proper disposal.
4. Facilities are operational, adequately ventilated, and regularly cleaned (Lepper et al., n.d.).

Image 46a. **Sample of a toilet facility**

Image 46b. **Sample of a hand washing area near the farm**

Source: Canva, n.d.

Although constructing concrete hand washing and toilet facilities on the farm can be costly, farmers may choose to improvise, provided that these facilities are kept clean, well-maintained, accessible to workers, and maintained in good hygienic condition.

Image 46c. **Sample of a portable toilet that can be used in large farms with huge or multiple production areas to ensure accessibility to farm workers**

4.11.1.5 Where employers are required to provide medical and health cover, any serious health issue is reported to the relevant health authority.

4.11.2 Farm Sanitation

4.11.2.1 Measures should be taken in order to ensure that the cultivation area is free from possible sources of contamination (e.g., litter, etc.).

Explanatory Note:

Image 47. **Signage or reminder for farm workers to avoid contaminating the cultivation area**

Aside from basic necessities for hand washing and disposal areas, reminders can help ensure that the area is minimized from contamination.

4.11.2.2 Packing, handling and storage areas that can be sources of contamination should be identified. Cleaning and sanitation procedures should be prepared and followed.

4.11.2.3 Appropriate cleaning and sanitation chemicals are selected to minimize the risk of these chemicals causing contamination of produce.

4.11.3 Equipment, Containers and Materials

4.11.3.1 Containers used for harvesting, handling and packing produce must never be used for hauling or storing agricultural chemicals, lubricants, oil, cleaning chemicals, plant or other debris, tools, etc.

4.11.3.2 Equipment, reusable harvesting containers, harvesting tools that comes in contact with fresh fruits and vegetables are made of non-toxic materials, and easily cleaned and disinfected. These implements and the farm vehicle should be regularly maintained.

Explanatory Note:

Below are samples of harvesting containers that are regularly cleaned.

Image 48a. **Clean harvesting crates for hasvesting produce**

Image 48a. **Crates for cleaning after use**

4.11.3.3 Equipment, containers and materials should be stored in a separate area away from chemicals, fertilizers and soil additives storage areas. Measures should be taken to minimize contamination from pests.

4.11.3.4 Containers for waste, by-products and inedible or dangerous substances should be specifically identifiable, suitably constructed and, where appropriate, made of impervious material. Where applicable, such containers should be lockable to prevent malicious or accidental contamination of fresh fruits and vegetables or agricultural inputs. Such containers should be segregated and identified so that they will not be used as harvesting containers.

4.11.4 Buildings and Structures

4.11.4.1 Building and structures used for production, packing, handling and storage of produce should be designed and constructed according to building standards and maintained to minimize the risk of contaminating the produce. Light bulbs should be shatter proof in areas where produce, packing containers and materials are exposed. In the event of bulb shattering, exposed produce is rejected while equipment, packing containers and materials are cleaned.

Explanatory Note:

The major requirements in constructing a packing house include:

- sufficient overhead protection from sun and rain;
- good ventilation but shielded from wind-blown rain and dust; and
- hard, level flooring for safety and efficient movement of workers and produce

For small-scale packing facilities, a simple structure made from bamboo, bush poles, or thatch may be enough. A more stable packing facility can be constructed of a wooden frame with a roof and walls of corrugated sheet metal over a concrete floor. In areas with intense sunlight, sheet-metal buildings produce excessive heat affecting both workers and produce. If sheet metal is used, it is essential to have a large ventilation space between the roof and the walls, and the roof itself has a large overhang. It might not be essential to construct walls if the roof is big enough to shield employees and produce from the sun and rain and if there are no issues with wind-blown dust or rain.

For permanent packing houses, usually, non-slip concrete floors with slopes toward drainage channels for easy cleaning are installed. Anti-dusting surface treatment of concrete is also advantageous (FAO, 1989).

Broken glass is a potential source of hazard. In case of breakage, workers, food products, packaging materials, and equipment can be exposed to broken glass, thereby, compromising their safety and the safety of consumers. In the case of fluorescent bulbs, shatterproof bulbs will contain Mercury, thus, reducing environmental hazards (Encapsulite, n.d.).

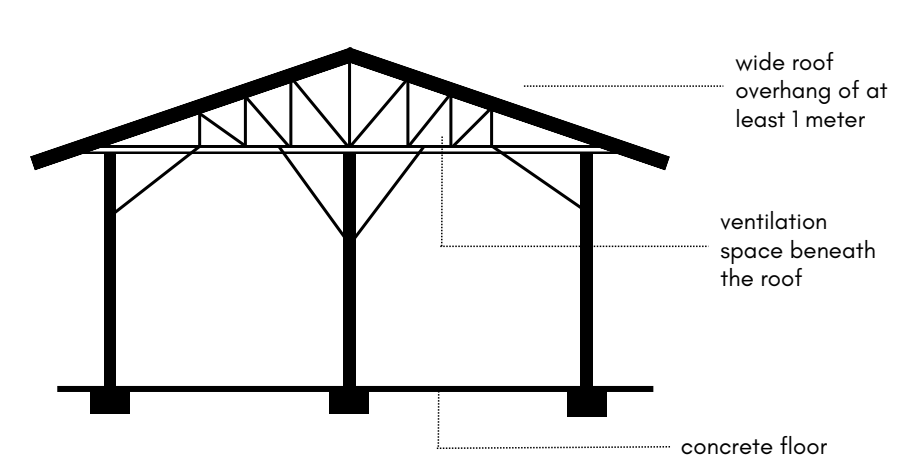


Image 49. **Illustration of a packing house structure**

4.11.4.2 There should be a separate designated packing area, where the produce is handled, packed and stored, away from oil, grease and machineries to prevent cross contamination.

Explanatory Note:

Ideally, a packing house should have:

- adequate space;
- layout that promotes a smooth flow of materials and personnel;
- safe and comfortable working conditions;
- clean facility and equipment; and
- accurate and up-to-date packing records.

Image 50a. **Designated packing area**

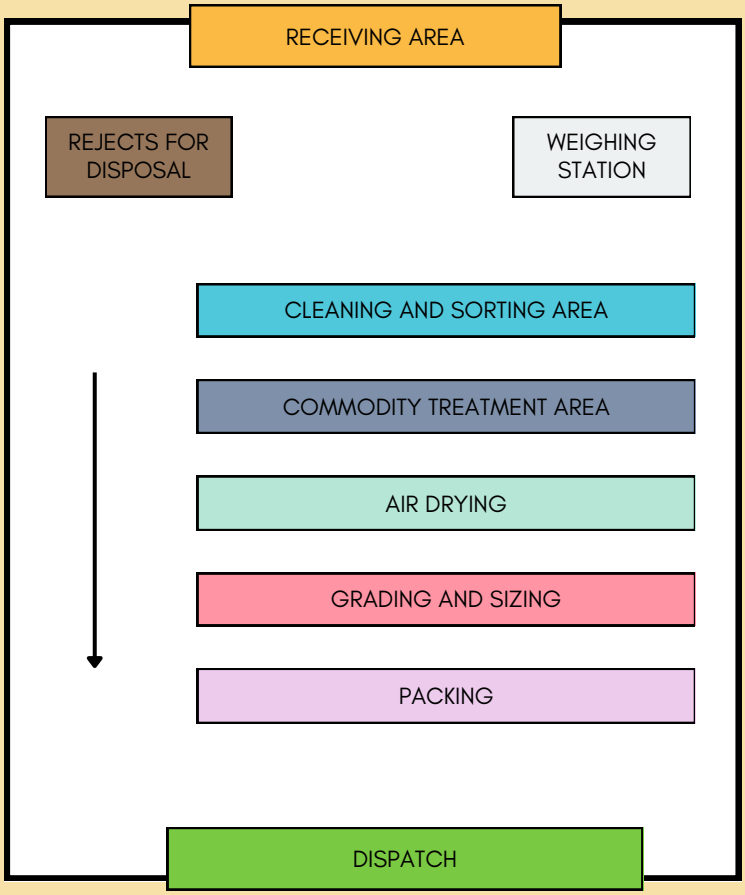


Image 50b. **Straight line flow operation of a packing facility**

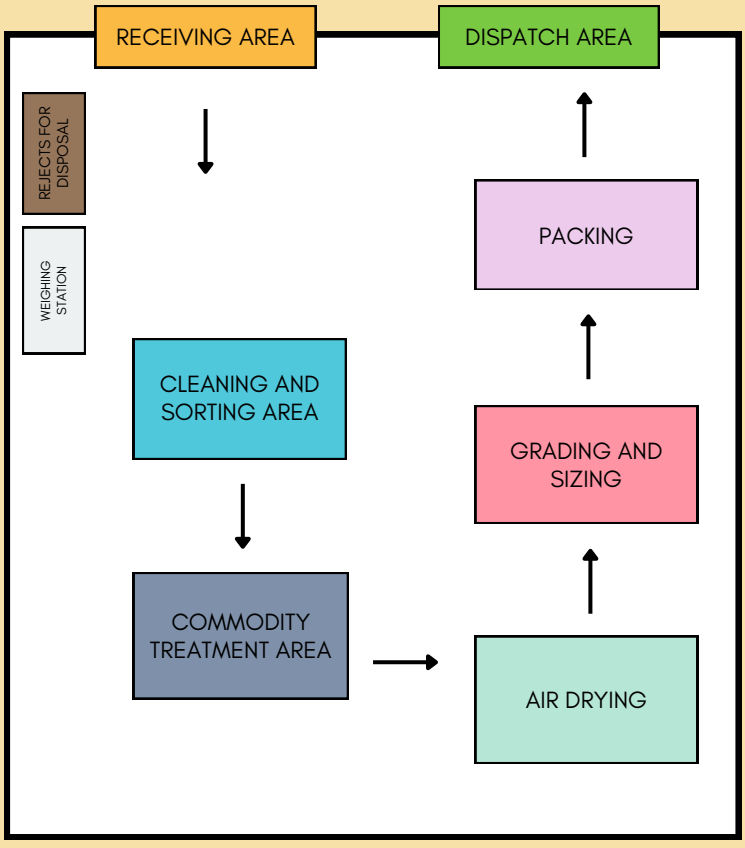


Image 50c. **U-shaped floor plan of a packing facility**

4.11.4.3 Sewage, waste disposal and drainage systems are constructed to minimize the risk of contaminating the production site and water supply.

4.11.5 Animals, Pest and Disease Control

4.11.5.1 Domestic and farm animals are excluded from the production site, particularly for crops grown in or close to the ground, and from areas where produce is harvested, packed and stored.

4.11.5.2 Measures should be taken to prevent the introduction of pests and diseases within the cultivation, handling, packing and storage areas.

Explanatory Note:

Aside from the hygienic practices and crop protection practices discussed in this PNS, one way to help prevent the introduction of pests and diseases is to limit or control access in the cultivation, handling, packing, and storage areas.

Image 51a. **Cultivation area is secured from the entry of domestic animals.**

Image 51b. **Packinghouse with plastic curtains or "fly curtain" to prevent entry of insects**

Image 51c. **Packing area is enclosed with a net that acts as barrier to prevent entry of pest**

4.11.5.3 Baits and traps used for pest control should be positioned and maintained in strategic areas to minimize the risk of contaminating the produce, packing containers and other handling materials. The location of baits and traps should be included in the building lay out map.

Explanatory Note:

Below are sample images of baits and traps for pest control.

Image 52a. **Mechanical rat trap**

Image 52b. **Sticky trap**

4.12 Worker's Health, Safety and Welfare

4.12.1 Training

4.12.1.1 Employers and workers must have appropriate knowledge or must have proper training on their areas of responsibility that are relevant to good agricultural practice.

Explanatory Note:

To have the necessary knowledge, the training can include instructions on measures that the workers need to follow to prevent or minimize the risk of the hazards to their health and safety. The training may take the form of on-the-job training or formal training. Refresher training and signs in the work area help to reinforce instructions for workers.

Image 54. **Certificates of training of farm workers on GAP**

4.12.1.2 Based on the area of responsibility of the workers, appropriate knowledge or training should be available on the following areas:

a) vehicles, equipment and tool operation;

b) accident and emergency procedures;

c) safe use of chemicals;

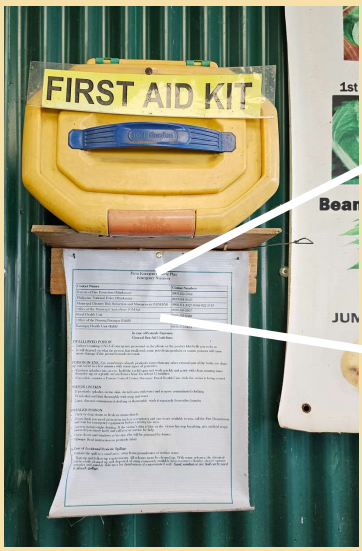
d) personal hygiene; and

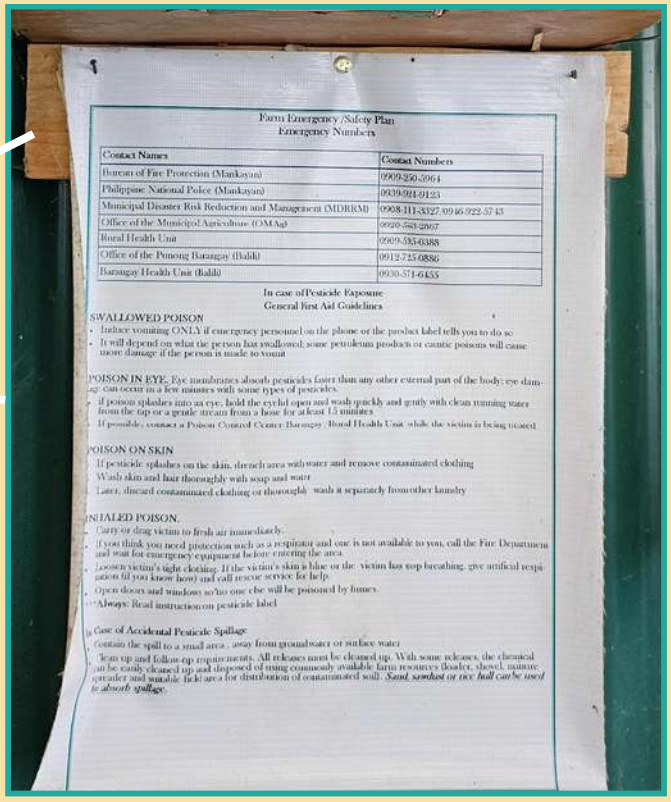
e) proper handling of produce.

4.12.1.3 Personnel working in packing houses should be able to practice good handling practices and Good Hygienic Practices (GHP); and aware of their role and responsibility in protecting fresh fruits and vegetables from contamination and deterioration. Packers should have the necessary knowledge and skills to enable them to perform packing operations and to handle fresh fruits and vegetables in a way that the potential for microbial, chemical and physical contamination are minimized.

4.12.1.4 There are documented, understandable and verbally communicated instructions made to the workers enabling them to know how to act in accident and emergency situations. These instructions should be available in the predominant languages of the workforce and should be displayed in conspicuous places.

Explanatory Note:





Farm Emergency /Safety Plan
Emergency Numbers

Contact Names	Contact Numbers
Bureau of Fire Protection (Mankayan)	0909-250-5964
Philippine National Police (Mankayan)	0939-921-9123
Municipal Disaster Risk Reduction and Management (MDRRM)	0908-111-8327; 0946-922-57 43
Office of the Municipal Agriculture (OMAg)	0920-593-2067
Rural Health Unit	0909-593-0388
Office of the Pinong Barangay (Balili)	0912-715-0886
Barangay Health Unit (Balili)	0930-571-6455

In case of Pesticide Exposure
General First Aid Guidelines

SWALLOWED POISON
- Induce vomiting ONLY if emergency personnel on the phone or the product label tells you to do so
- It will depend on what the person has swallowed; some petroleum products or caustic poisons will cause more damage if the person is made to vomit

POISON IN EYE. Eye membranes absorb pesticides faster than any other external part of the body; eye damage can occur in a few minutes with some types of pesticides.
- If poison splashes into an eye, hold the eyelid open and wash quickly and gently with clean running water from the tap or a gentle stream from a hose for at least 15 minutes
- If possible, contact a Poison Control Center Barangay/ Rural Health Unit while the victim is being treated

POISON ON SKIN
- If pesticide splashes on the skin, drench area with water and remove contaminated clothing
- Wash skin and hair thoroughly with soap and water
- Later, discard contaminated clothing or thoroughly wash it separately from other laundry

INHALED POISON.
- Carry or drag victim to fresh air immediately.
- If you think you need protection such as a respirator and one is not available to you, call the Fire Department and wait for emergency equipment before entering the area.
- Loosen victim's tight clothing. If the victim's skin is blue or the victim has stop breathing, give artificial respiration (if you know how) and call rescue service for help.
- Open doors and windows so no one else will be poisoned by fumes.
- Always: Read instruction on pesticide label

Case of Accidental Pesticide Spillage
- Contain the spill to a small area ; away from groundwater or surface water
- Clean up and follow-up requirements. All releases must be cleaned up. With some releases, the chemical can be easily cleaned up and disposed of using commonly available farm resources (loader, shovel, manure spreader and suitable field area for distribution of contaminated soil. *Sand, sawdust or rice hull can be used to absorb spillage.*

Image 54. **Sample instructions in case of pesticide exposure displayed within the facility**

4.12.1.5 Safe manual handling practices are followed to minimize the risk of injury from lifting heavy objects and excessive twisting and reaching movements.

Explanatory Note:

Manual handling is an activity requiring force to lift, lower, push, pull, carry, or otherwise move, hold, or restrain any static or moving load. Heavy lifting, work requiring poor posture, and repetitive work can cause back, joint, and muscle problems to workers.

Following safe manual handling practices can help reduce the human requirement to lift excessive weights, bend or twist, exert excessive push/pull forces, adopt uncomfortable postures for long periods, and minimize repetitive work. Examples of safe practices are enumerated below:

- Use mechanical aids like slings, hoists, trolleys, wheelbarrows, and conveyors.
- Opt for smaller and lightweight containers, bags, and materials.
- Deliver and place heavy items as close as possible to work areas.
- Substitute manual handling of fertilizer bags with bulk bags and mechanical equipment.
- Adjust bench heights to suit the worker.
- Ensure tools are within easy reach.
- Train workers in safe manual handling practices and encourage prompt injury reports.
- Provide protective clothing and equipment such as gloves (ASEAN, 2007).

4.12.1.6 New workers should be oriented by trained officer about the risks associated with health and safety when starting at the worksite.

4.12.2 Worker's Welfare

4.12.2.1 In case living quarters are provided by an employer, the structure must be suitable for human habitation and contain basic services and facilities.

Explanatory Note:

Basic services and facilities are adequate sleeping quarters that are not overcrowded and hygienic kitchen facilities, toilets, and hand washing facilities.

4.12.2.2 The farm should employ workers at least 18 years old.

4.13 Waste Management and Energy Efficiency

4.13.1 A farm should have an operational waste management plan and should be properly followed.

4.13.2 Consumption of electricity and fuel should be monitored and reviewed for efficient and optimized operation in which power and fuel bills may be of assistance.

4.13.3 Machinery and equipment should be serviced to maintain operational efficiency.

4.14 Traceability and recall

4.14.1 Records of production, processing and distribution should be maintained for two (2) years to facilitate a food borne illness investigation and recall, if any.

Explanatory Note:

Records enable tracing back of consignments to investigate possible causes of food safety problems and also provide evidence for auditors and customers that good agricultural practices have been implemented.

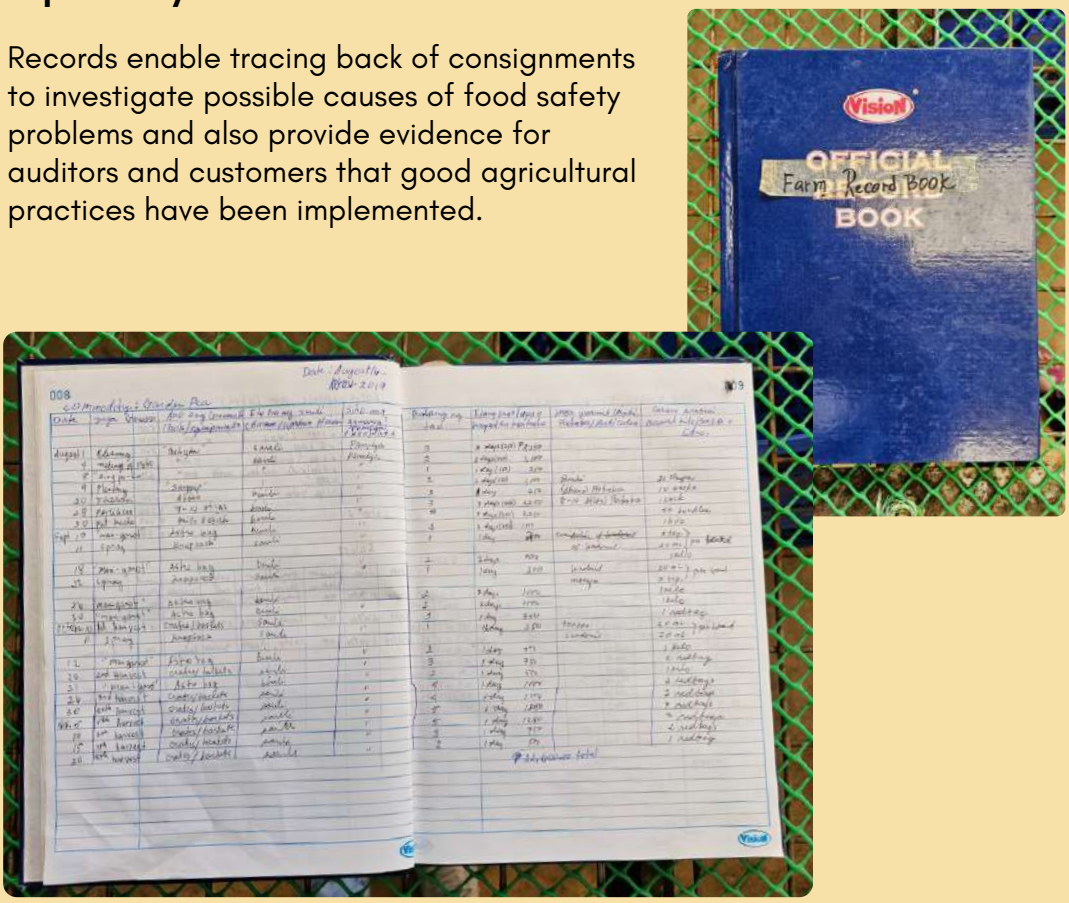


Image 55. **Sample of an actual logbook or record book**

4.14.2 Growers and/or packers should always update all relevant information on agricultural activities such as the site of production, suppliers' information on agricultural inputs, lot numbers of agricultural inputs, irrigation practices, use of agricultural chemicals, water quality data, pest control and cleaning schedules for indoor establishments, premises, facilities, equipment and containers.

4.14.3 A record should also be kept on the following specifics: date of supply, quantity of produce and destination for each consignment of produce.

4.14.4 Growers and packers should have programs to ensure effective lot identification. These programs should be able to trace the sites and agricultural inputs involved in primary production and the origin of incoming material at the packing establishment in case of suspected contamination.

Explanatory Note:

To help record and update relevant information on agricultural activities, simple methods can be used to identify the farm. Examples are attaching a card or label onto the container with the name of the farm or using a particular color for the container. Markings and labels should be waterproof to prevent deterioration.

If more than one production site is present on a farm, marking the site name or code on the container enables trace back to each production site. For example, the letter "A" marked on a container would indicate that the produce was harvested from Block A.

Similarly, where produce is harvested several times from one production site, traceability is enhanced by marking the date of packing or a code on the container. An example of a packing code is the day number for the month and the year – for example, 240923 would refer to the 24th day of September 2023.

Where produce from more than one farm is packed together in the same container, the name of the farm or a code is marked on each container to identify the farm. For example, each farm could be allocated a number and the number is then marked on the container (ASEAN, 2006).

Image 56. **Sample of plastic crates differing in color for traceability**

4.14.5 Packed containers must be clearly labeled with an identification to enable traceability of the produce to the farm or site where the produce is grown.

4.14.6 When produce is identified as being contaminated or potentially contaminated, the produce is isolated and distribution prevented or if sold, the buyer is immediately notified.

4.14.7 The cause of any contamination is investigated and corrective actions are taken to prevent re-occurrence and a record is kept of the incident and actions taken.

4.15 Documentation and Records

4.15.1 Site History and Management

4.15.1.1 In case of new sites, a record should be kept for all potential hazards identified during the assessment. Whenever remedial action is required to manage the risk, a record should be kept on the action taken and the results thereof.

4.15.1.2 In case of multiple production areas in a site, the name or code of each production area should be indicated in all documents and recorded.

4.15.2 Planting Material

4.15.2.1 Whenever a planting material is produced within the farm or from non-accredited farm sources, chemical used for treatment and purpose of the treatment should be documented.

4.15.2.2 In case planting materials are procured from accredited nurseries or seed producer, the name and specifics of the cultivar, the name of the supplier, and the date of procurement should be record.

4.15.3 Fertilizers and Soil Additives

4.15.3.1 A record of fertilizers and soil additives obtained should be kept with the following specifics: source, product name, and date and quantity obtained.

Explanatory Note:

Image 57. **Record of application of fertilizer**

4.15.3.2 The application of fertilizers and soil additives, chemical fumigants and alternatives to sterilize soils and substrates should be recorded, detailing the following: date, name of the product or material used, treatment location, application rate, application method, and operator name.

4.15.3.3 Records of procurement, inventory and utilization of inorganic fertilizers should be maintained and updated regularly. These should include: source, product name, date and quantity, expiration date (for liquid fertilizers) and the nutrient composition of the materials.

4.15.3.4 Treatment of organic fertilizer materials prior to application should be documented. The method, date and duration of the treatment should be recorded. The level of pathogen reduction (*E. coli* and *Salmonella* should be zero) achieved by different treatments should be documented and supported by laboratory analyses.

4.15.3.5 The farm should maintain a documented maintenance program for the equipment used for the application of fertilizers and soil additives.

4.15.4 Water

4.15.4.1 A documentation should be kept for any occurrence of significant hazards during the assessment of source of irrigation water. If contamination occurs, corrective actions should be carried out and actions taken should be properly documented.

4.15.4.2 Where available, a record of the water testing results should be kept.

4.15.4.3 If water treatment is done, a record of the treatment method/s used and the monitoring results should be kept.

4.15.4.4 A record is kept of irrigation use, detailing crop, date, location, volume of water applied or duration of irrigation, unit area, and name of person who managed the irrigation activity.

4.15.5 Crop Protection

4.15.5.1 A record of procured chemicals should be kept, with the following details: chemical name, supplier of the chemical, date of purchase, expiry dates, and quantity procured.

4.15.5.2 After application, the following should be recorded: name of applicator, name of product/s used, application rate, frequency of application, method of application, date of application and PHI.

4.15.5.3 If chemical residues in excess of the MRL are detected, the cause of the contamination is investigated, corrective actions are taken to prevent re-occurrence, and a record is kept of the incident and actions taken.

4.15.5.4 In order to avoid expired chemicals, a record or inventory of stored chemicals should be kept with the following details: chemical name, date and quantity obtained, expiry date and date when completely used or disposed of.

4.15.5.5 Records of maintenance and calibration activities for agricultural chemical sprayers should be kept.

4.15.5.6 The records must always be accessible during inspection of the farm.

4.15.6 Harvest and Postharvest Treatment

4.15.6.1 If applicable, farm storage areas temperature and humidity are recorded.

4.15.6.2 Application of postharvest agrichemical should be recorded and maintained with the following information:

a) produce identity (i.e., lot or batch of produce);

b) location of application;

c) application dates;

d) pest or disease treated (common name);

e) type of treatment;

f) product trade name/formulation;

g) product quantity applied; and

h) operator's name.

4.15.6.3 Documented records should be kept for the cleaning and maintenance of produce handling facilities and equipment.

4.15.7 Animals, Pest and Disease Control

4.15.7.1 Actions taken for animal, pest and disease control and monitoring must be recorded.

4.15.8 Workers' Health, Safety and Welfare

4.15.8.1 A record of personnel orientation training on personal hygiene practices, risks associated with and health safety, and programs relevant to good agricultural practices should be kept.

4.15.8.2 Records should indicate that the required instructions or training program are in place and copies of attendance certificates or a signed list of workers who attended the training course(s) must be compiled.

4.15.9 Waste Management

4.15.9.1 Disposal of rejected produce and waste materials should have documented records.

4.15.9.2 Farm waste management plan should be properly documented including the: types of waste products generated by property activities, practices to minimize waste generation, reuse or recycling of waste, and storage and disposal of waste.

4.15.9.3 Out of date documents are disposed and only current versions of documents relevant to good agricultural practice are used.

4.15.9.4 Written and/or documentary accounts should be kept which enables the official or officially recognized certification body/authority to trace the origin, nature and qualities of all raw materials bought and the use of such materials. In addition, written and/or documentary account should be kept of the nature, quantities, and consignees of all agricultural products sold. Quantities sold directly to the final consumers should preferably accounted on a daily basis.

4.16 Internal Self-inspection

4.16.1 The grower should conduct a documented annual internal self-inspection. Effective corrective actions should be implemented if necessary.

Explanatory Note:

Internal self-inspection is necessary to confirm that practices are being carried out as required and records are accurate and contain the required information. This self-assessment identifies the practices that are not being done correctly and actions needed to investigate and rectify the problem (ASEAN, 2006).

It is advisable to self-inspect or review the practices while they are being carried out. For instance, during harvest time, it's important to review the practices related to harvesting and preparing the product for sale (ASEAN, 2006).

Annex A

Maturity Indices of Fruits and Vegetables

Photo source: Canva, n.d.

Harvesting fruits and vegetables at the right stage of maturity is to ensure desirable eating qualities. Below are the maturity indices for select fruits and vegetables.

A. Vegetables	Indicator
Most vegetables (e.g. beans, okra, cucumber, luffa, bittergourd, eggplant)	• tender • immature • attainment of desired size • no seed bulging
Most fruit vegetables (e.g. tomato, bell pepper, squash)	mature showing tinge of color change
Bulbs and rootcrops	drying and toppling of upper leaves of standing plant
Cabbage, broccoli, cauliflower	• compact head • attainment of desired size
Iceberg or heading lettuce	soft, loosely-packed leaves
B. Fruits	**Indicator**
Mango	• flattening of shoulder • 110-120 Days after flower induction • fullness of cheeks • sinker in 1% salt solution
Banana	• drying of plant leaves • reduced angularity of fingers
Pineapple	• widening of grooves • bottom layer of shells or eyes show tinge of yellowing
Papaya	tinge of yellow (color break) at the apical end of the fruit
Jackfruit	widening of grooves and flattening of spikes

Rambutan and lanzones	• red color of peel and spinterns • straw yellow and brown peduncle for lanzones
Strawberry	mature showing tinge of color change
Avocado	loss of skin gloss
Calamansi	> 2cm diameter
Muskmelon	1/2 to 3/4 slip melon can be pushed with moderate thumb pressure from stem

Source: UPLB-PHTRC, n.d.

Annex B

Sample Infographics of Grading and Classification

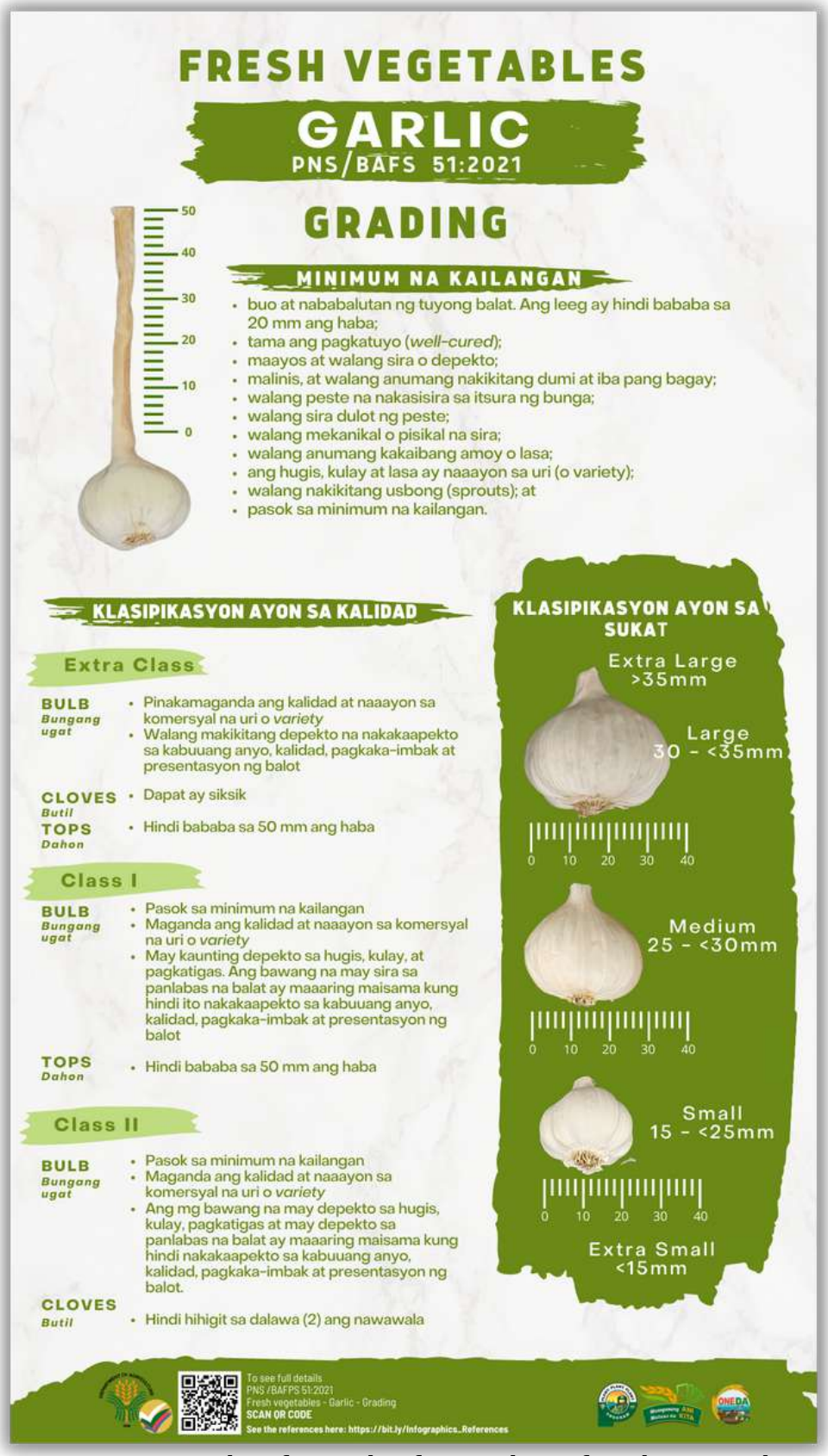


Image 58a. **Sample infographic for grading of garlic according to PNS/BAFS 51:2021**

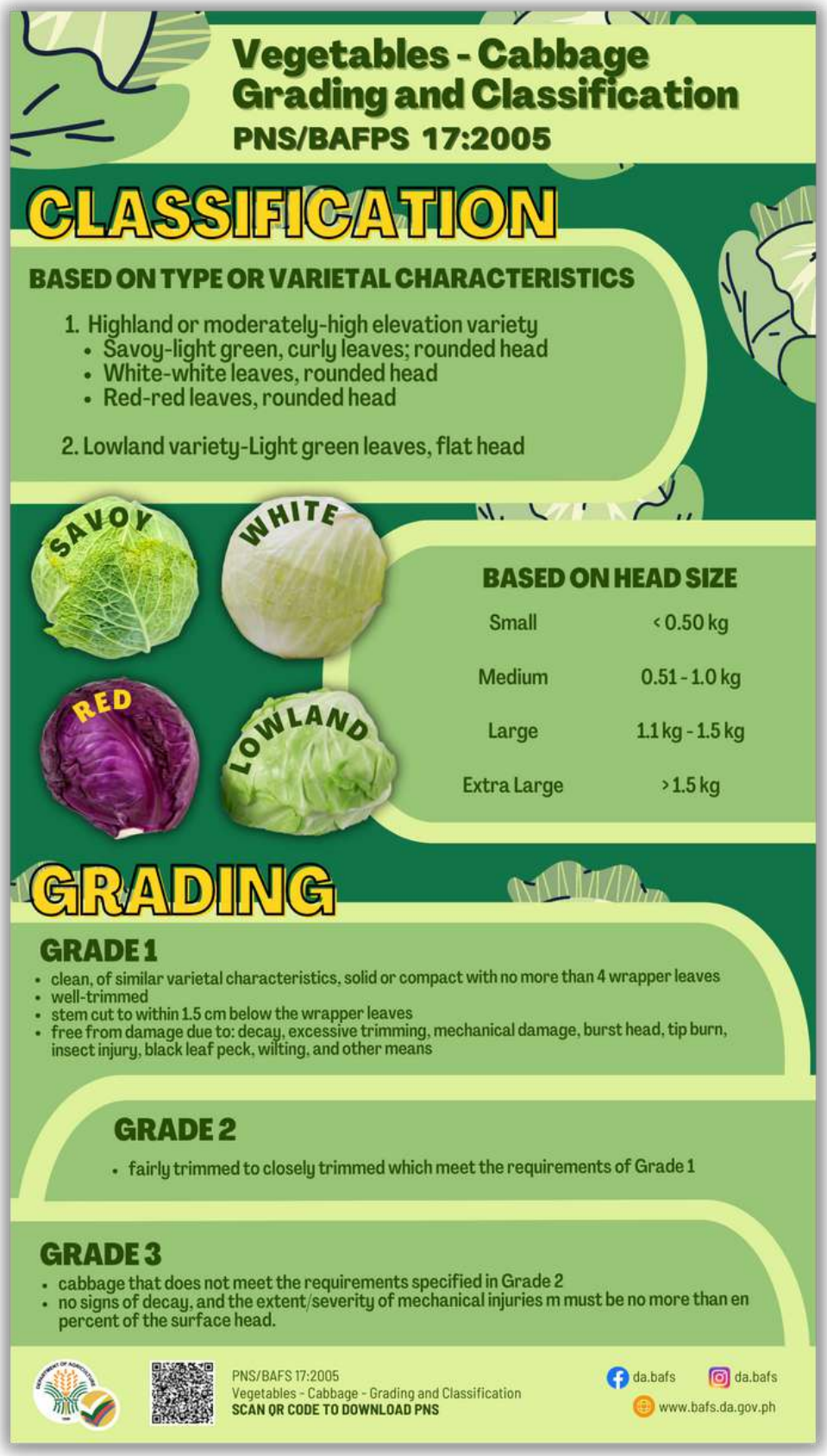


Image 58b. **Sample infographic for grading and classification of cabbage according to PNS/BAFPS 17:2005**

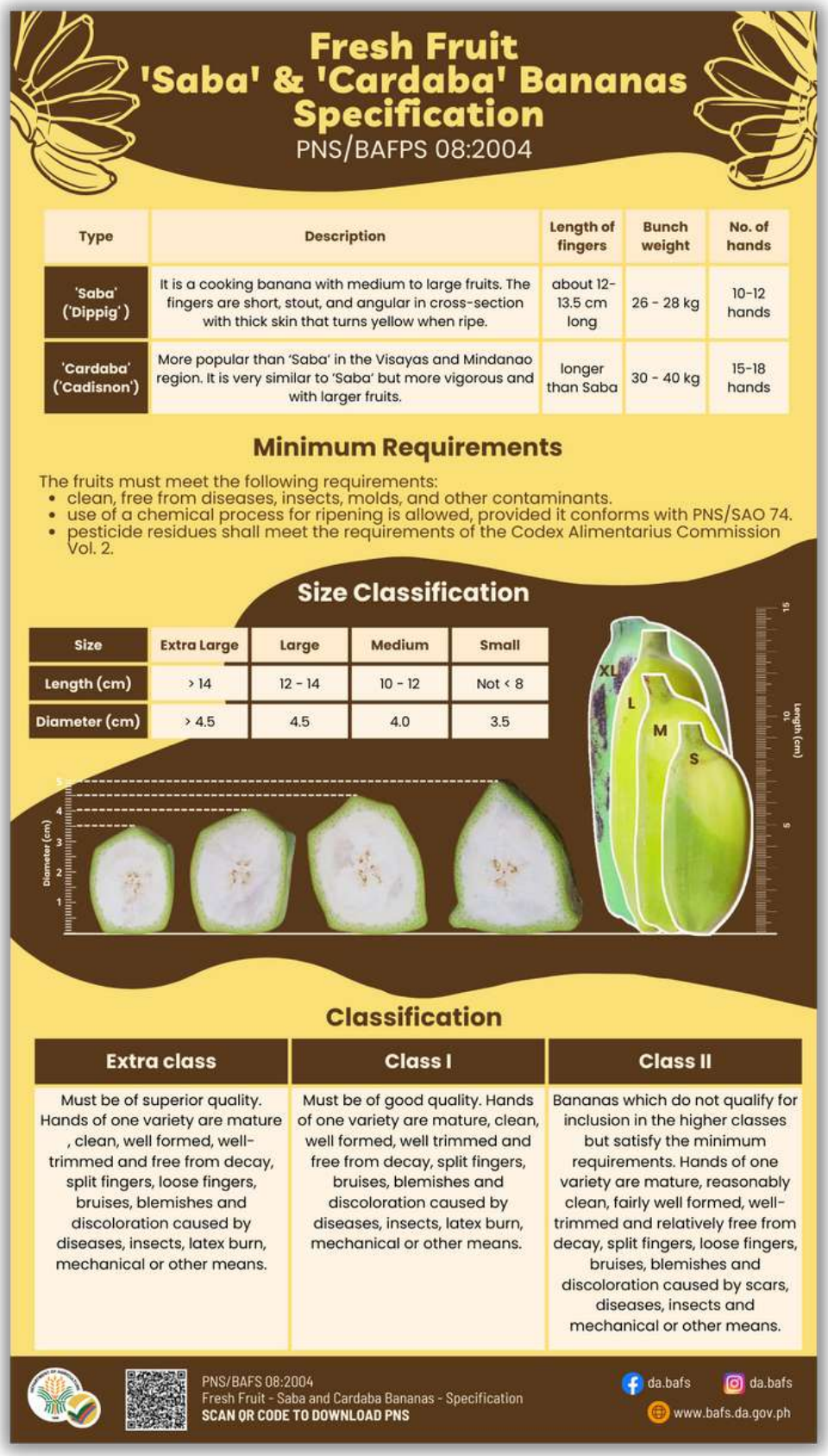


Image 58c. **Sample infographic for classification of saba and cardaba banana according to PNS/BAFPS 08:2004**

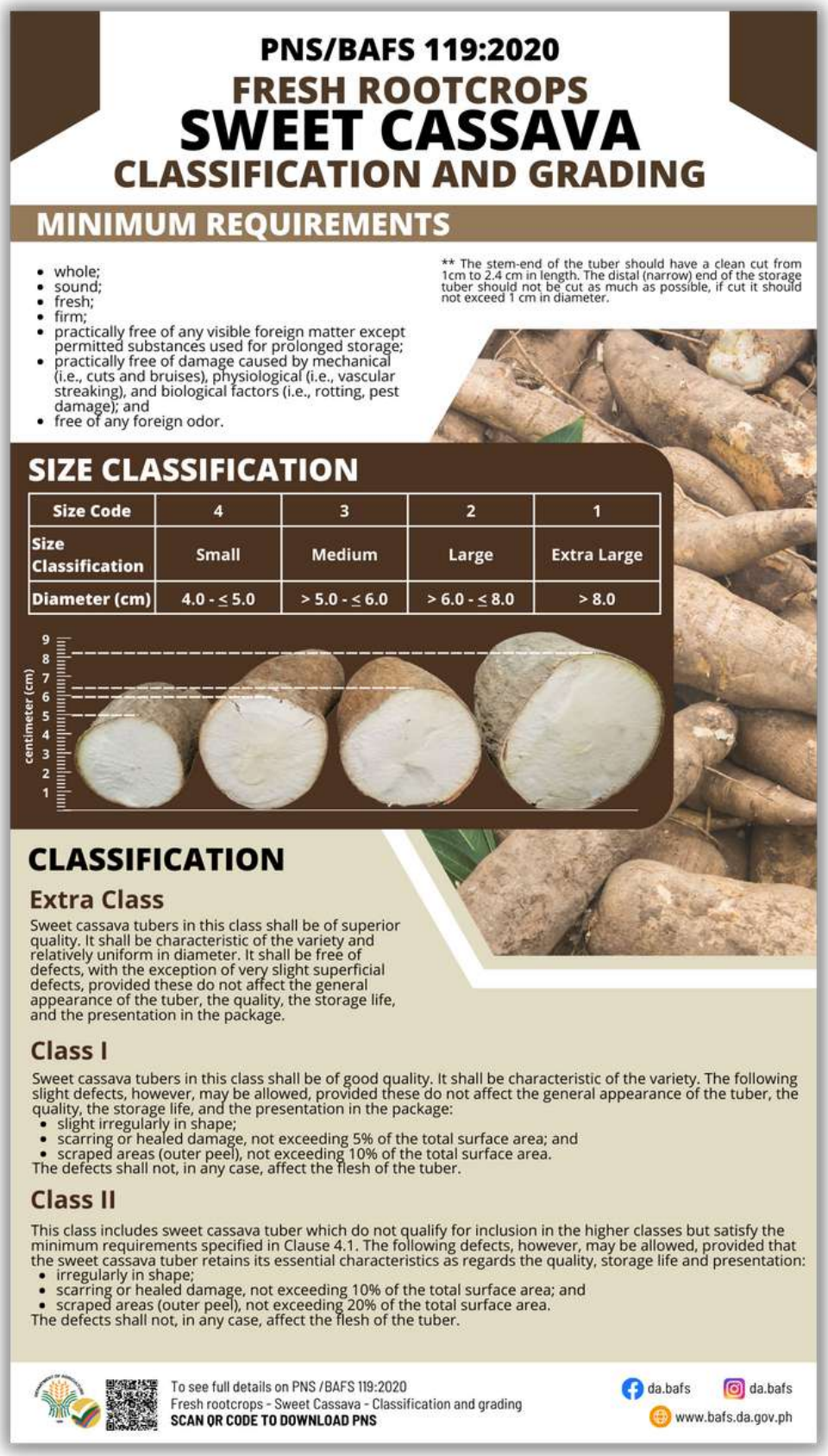


Image 58d. **Sample infographic for grading and classification of sweet cassava according to PNS/BAFS 119:2020**

Image 58e. **Sample infographic for grading and classification of baby corn according to PNS/BAFS 234:2018**

Image 58f. **Sample infographic for grading and classification of calamondin/calamansi according to PNS/BAFPS 30:2005**

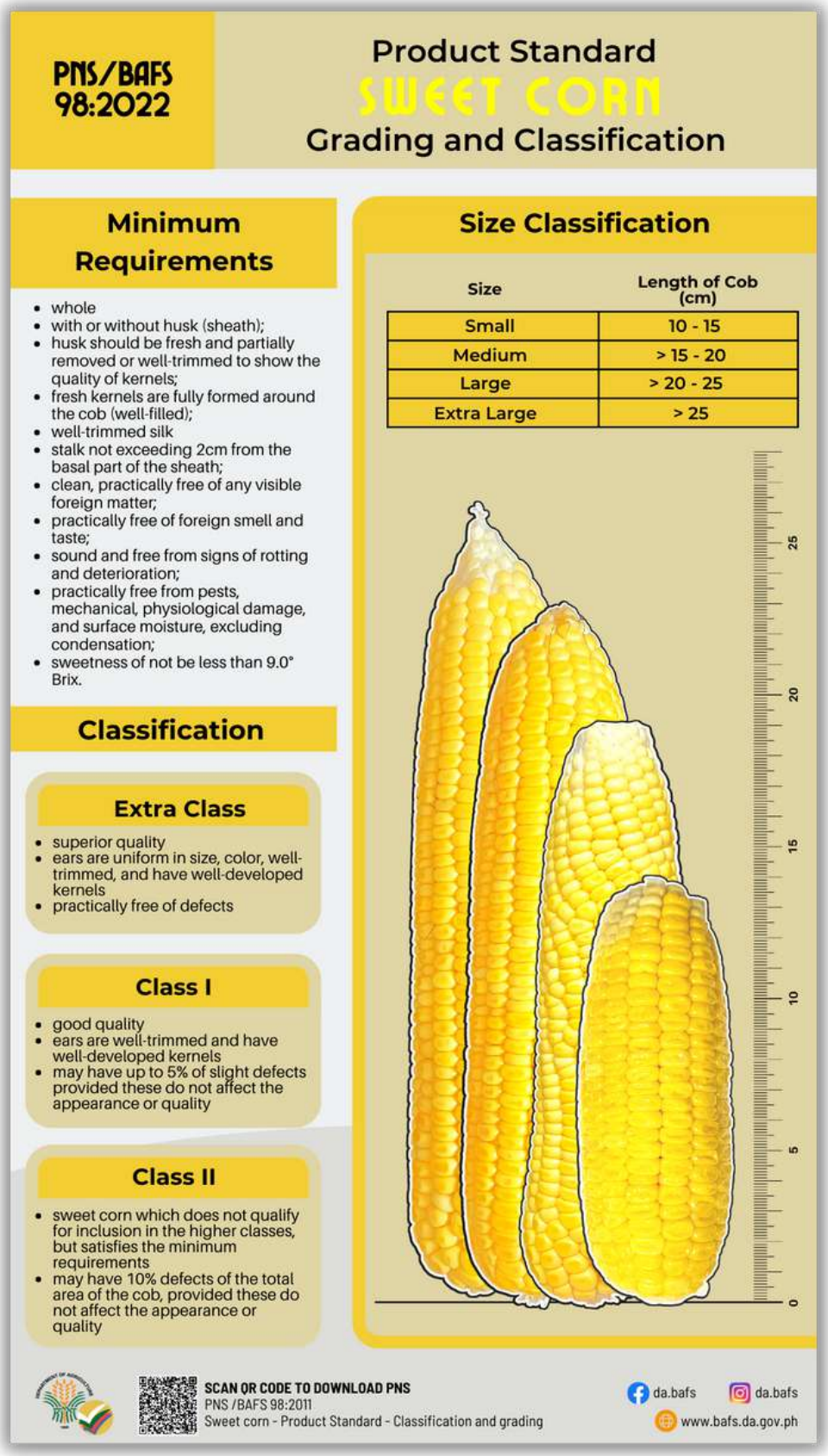


Image 58g. **Sample infographic for classification of sweet corn according to PNS/BAFS 98:2022**

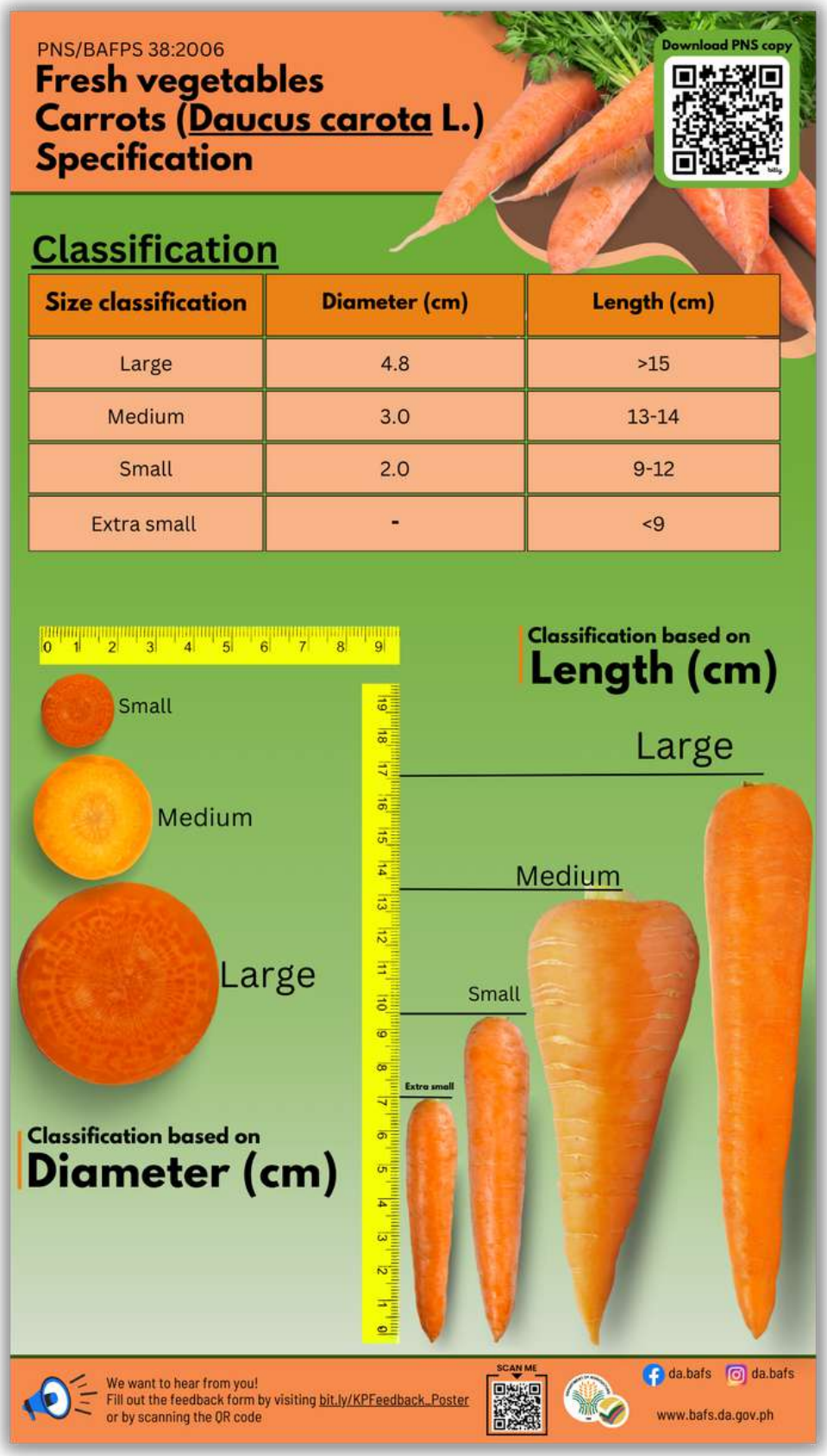


Image 58h. **Sample infographic for classification of carrots according to PNS/BAFPS 38:2006**

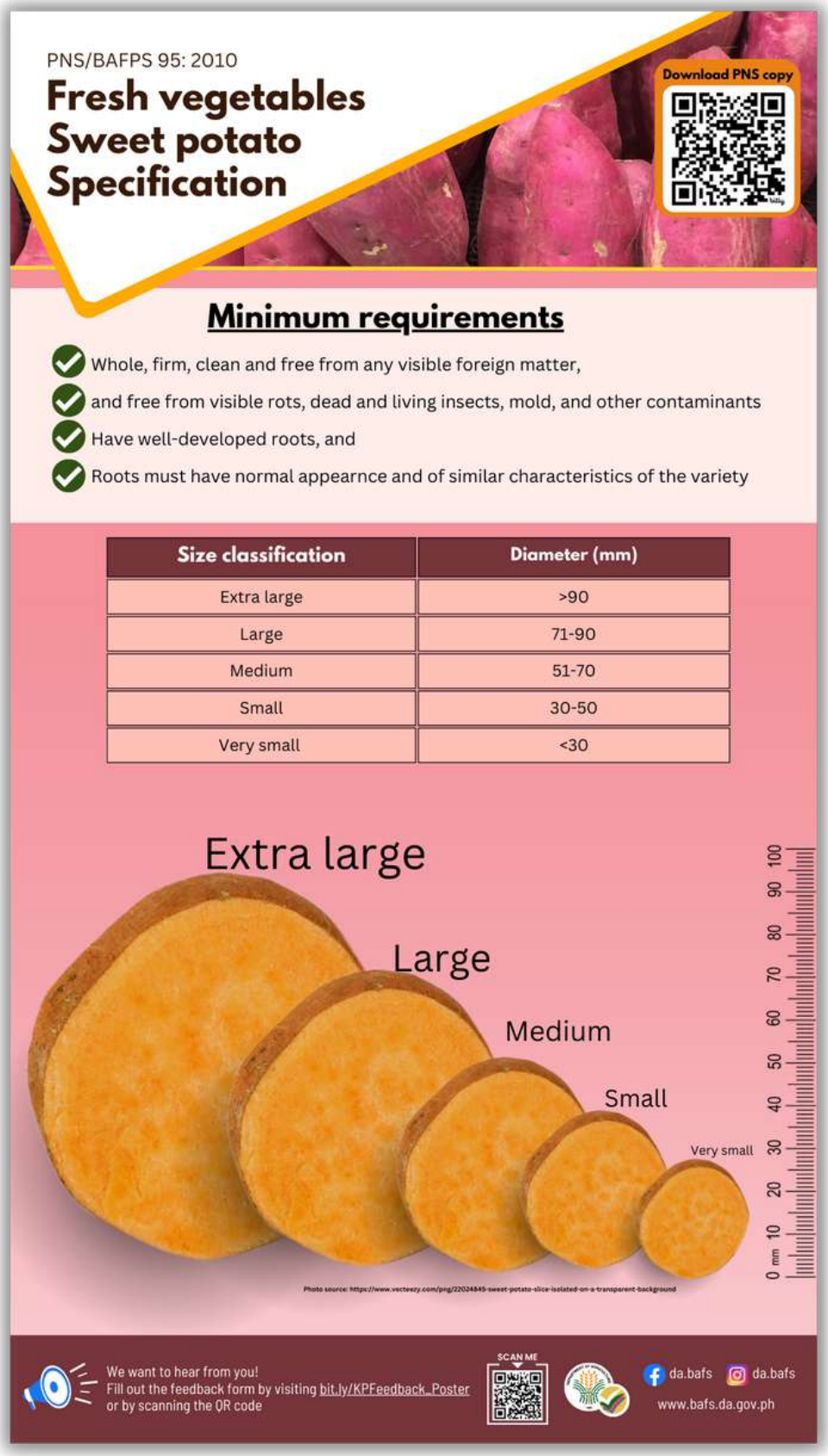


Image 58i. **Sample infographic for classification of sweet potato according to PNS/BAFPS 95:2010**

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Photo source: Canva, n.d.

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Technical Working Group

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This Explanatory Manual (EM) serves as a supplementary learning material for the Philippine National Standard (PNS) Code of Good Agricultural Practices (GAP) for Fruits and Vegetable (FV) Farming - Code of Practice (PNS/BAFS 49:2021). The EM aims to aid stakeholders by promoting uniform understanding and interpretation of the PNS to ensure efficient adoption and implementation of the Standard.

PNS/BAFS 49:2021 was developed to support Filipino farmers and to promote sustainable farming.


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